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TRANSACTIONS

—OF—

The National Association of Cotton Manufacturers.

SUCCESSOR TO

New England Cotton Manufacturers' Association,

ORGANIZED AS THE HAMPDEN COUNTY SPINNERS' ASSOCIATION.

Founded 1854. **Incorporated Dec. 1, 1894.**

NO. 81.

SEMI-ANNUAL MEETING.

Held at Hotel Champlain, Clinton County, N. Y.

SEPTEMBER 12 and 13, 1906.

Office of the Association:

Room 57, International Trust Building, 45 Milk Street,
Corner of Devonshire St., Boston, Mass.

1907.

THE GIFT OF

Association.

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The National Association of Cotton Manufacturers.

Proposal for

.....

Membership of

.....

NOTICE TO MEMBERS.

To make The National Association of Cotton Manufacturers the representative body which its name implies and to broaden the organization as far as possible, it must include more of those who are eligible for membership.

It has been found that many who were eligible and desired to join had not done so because not invited. It is hoped that every member will present the matter to eligible non-members among his associates. The accompanying blank proposition for membership can be detached from the cover at the row of perforations.

The National Associati
of Cotton Manufactur

SUCCESSOR TO

New England Cotton Manufacturers' Associa

Room 57, International Trust Building,

45 MILK STREET,

BOSTON, MASS.

PROPOSAL FOR MEMBERSHIP.

(When filled out, to be mailed at any time to the Secretary, P. O. Box 3672, Boston, Mass., for action by the Board of Government, at least one week before a meeting of the Association.)

Mr. .....

State first name as well as surname.

Position, ...

Business Connection, ...

Name of corporation or firm.

P. O. Address, ...

Number. Street.

....

City or town. State.

is proposed for ..... *membership in* THE NATIONAL ASSOCIATION

active or associate

OF COTTON MANUFACTURERS *by* .....

signature of member proposing candidate.

a member of the Association.

The undersigned certifies that the above statements are correct, and agrees that, if elected to the Association, he will be governed by its rules as long as his connection with it shall continue.

Date, ... 190 .

.....

signature of candidate.

REMARKS: It is desired that the proposer will supply such additional information as will aid in determining the eligibility of the applicant.

TRANSACTIONS

—OF—

The National Association of Cotton Manufacturers.

SUCCESSOR TO

New England Cotton Manufacturers' Association,

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Corner of Devonshire St., Boston, Mass.

1907.

ENTERED ACCORDING TO ACT OF CONGRESS
IN THE YEAR 1907
BY THE NATIONAL ASSOCIATION OF COTTON MANUFACTURERS
IN THE OFFICE OF THE LIBRARIAN OF CONGRESS
AT WASHINGTON.

By vote of the Board of Government, the price of the *Transactions* is $5.00 per copy to non-members. The price of this issue and the one previous is $1.00 each to members, and the prices of copies previous to Volume 61, is 50 cents to members, but each member is entitled to a copy as a part of the privilege of membership.

CHARTER.

No. 6091.

Commonwealth of Massachusetts.

BE IT KNOWN, That whereas, EDWARD W. THOMAS, C. J. H. WOODBURY, WILLIAM J. KENT, F. M. MESSENGER, HARRY T. WHITIN, ARTHUR H. LOWE, ALBERT F. KNIGHT, ALFRED M. GOODALE, FRED C. MCDUFFIE and GEORGE W. BEAN have associated themselves with the intention of forming a corporation under the name of the NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION, for the purpose of encouraging scientific investigation and experiment as to the methods of manufacturing cotton; collecting and imparting information relating to this industry, promoting social intercourse among its members; and establishing and maintaining a library of works on textiles in the city of Boston, and have complied with the provisions of the Statutes of this Commonwealth in such case made and provided, as appears from the certificate of the President, Treasurer and Directors of said corporation, duly approved by the Commissioner of Corporations, and recorded in this office.

Now, Therefore, I, WILLIAM M. OLIN, Secretary of the Commonwealth of Massachusetts, do hereby certify that said EDWARD W. THOMAS, C. J. H. WOODBURY, WILLIAM J. KENT, F. M. MESSENGER, HARRY T. WHITIN, ARTHUR H. LOWE, ALBERT F. KNIGHT, ALFRED M. GOODALE, FRED C. MCDUFFIE and GEORGE W. BEAN, their associates and successors, are legally organized and established as and are hereby made an existing corporation under the name of the

NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION,

with the powers, rights and privileges, and subject to the limitations, duties and restrictions which by law appertain thereto.

Seal of the Commonwealth of Massachusetts.

Witness my official signature hereunto subscribed, and the seal of the Commonwealth of Massachusetts hereunto affixed this first day of December, in the year of our Lord one thousand eight hundred and ninety-four.

WILLIAM M. OLIN,

Secretary of the Commonwealth.

197081

Commonwealth of Massachusetts.

(Acts of 1895, Chap. 163.)

AN ACT TO AUTHORIZE THE NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION TO HOLD ITS MEETINGS WITHOUT THE COMMONWEALTH.

Be it enacted, etc., as follows:

SECTION 1. The New England Cotton Manufacturers' Association is hereby authorized to hold its meetings in any state or territory of the United States and in the District of Columbia; provided, however, that its annual meeting shall be held in this Commonwealth at least once in five years.

SECT. 2. This act shall take effect upon its passage. [Approved March 23, 1895.]

No. 252.

Commonwealth of Massachusetts.

BE IT KNOWN that whereas

NEW ENGLAND COTTON MANUFACTURER'S ASSOCIATION,

a corporation organized under the laws of this Commonwealth and subject to the provisions of chapter one hundred and twenty-five of the Revised Laws has complied with the provisions of chapter one hundred and nine of the Revised Laws, as appears from the certified copy of the order of the Commissioner of Corporations, authorizing said corporation to change its name and adopt the name of

THE NATIONAL ASSOCIATION OF COTTON MANUFACTURERS,

and the certificate of the Vice-President and Acting President, Treasurer and Directors of said corporation duly filed in this office pursuant to the provisions of section ten of the aforesaid chapter one hundred and nine of the Revised Laws.

NOW THEREFORE, I, William M. Olin, Secretary of the Commonwealth of Massachusetts, DO HEREBY CERTIFY, that the name which said corporation shall bear is

THE NATIONAL ASSOCIATION OF COTTON MANUFACTURERS,

which shall hereafter be its legal name.

Seal of the Commonwealth of Massachusetts.

WITNESS my official signature hereunto subscribed, and the Great Seal of the Commonwealth of Massachusetts hereunto affixed this twenty-fifth day of June in the year of our Lord one thousand nine hundred and six.

WM. M. OLIN,
Secretary of the Commonwealth.

THE

NATIONAL ASSOCIATION OF COTTON MANUFACTURERS.

SUCCESSOR TO

NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION.

FOUNDED 1854.

INCORPORATED DECEMBER 1, 1894.

CONSTITUTION AND BY-LAWS.

ACTIVE MEMBERS.

ARTICLE 1. Any person who is actively engaged as President, Treasurer, Agent, Superintendent or Manager in the manufacture, printing or finishing of cottons shall be eligible for active membership.

ELECTION OF MEMBERS.

ARTICLE 2. All nominations for membership shall be made in writing, at least one week before the date of any regular meeting, and shall be considered by the Board of Government, and reported to the meeting, favorably or adversely, for the action of the Association. *Provided*, that in case the Board shall decide to report adversely upon any nomination, the member who shall have made it shall be informed of the intention so to report, in order that he may have an opportunity to withdraw the name. Upon such report active members may be admitted, if they obtain a majority of votes of the members present and voting therefor, by acceptance in writing, and paying an admission fee of ten dollars, and maintaining their membership by the payment of an annual assessment not exceeding ten dollars.* Any member failing to pay two successive assessments shall cease to be a member at the end of six months from the date when such second assessment shall become due. Any member may withdraw from the Association upon payment of all arrearages, first giving notice of his intention so to do, in writing, to the Secretary, and the Board of Government may

* This assessment has never exceeded five dollars for active members and ten dollars for associate members.

accept such resignation; and any member may be expelled for cause, at any regular meeting, two-thirds of the members present voting therefor.

ASSOCIATE MEMBERS.

ARTICLE 3. Persons engaged in the manufacture of cotton or cotton fabrics, or the manufacture of textile machinery, or industries kindred to the cotton manufacture, may become associate members of the Association. The methods of application, nomination, election and withdrawal from the Association being under the same conditions as those provided for active members in Article 2 excepting that this class of membership does not carry with it the privilege of voting or speaking, except by permission from the Board of Government or a vote of the Association to allow permission.

The initiation fee for associate members shall be twenty-five dollars, and the annual assessment shall be double the sum annually voted for active members.

Associate members may be expelled by a majority vote of the Board of Government.

HONORARY MEMBERS.

ARTICLE 4. Honorary members may be elected, when recommended by the Board of Government, at any regular meeting of the Association, who shall be enrolled as such, and shall be entitled to attend the meetings of the Association and participate in its proceedings, without the right to vote. They shall not be subject to payment of admission fees or assessments. No person actively engaged in cotton manufacture shall be eligible to honorary membership.

LIFE MEMBERS.

ARTICLE 5. Any active or associate member by the single payment of one hundred dollars shall be exempt from all future payments for dues and shall become a life member having all the privileges of active members.

All moneys thus paid shall be invested as a permanent fund by the Treasurer acting under the direction of the Board of Government, of which the income only shall be subject to appropriation for current expenses.

ARTICLE 6. It shall be the duty of all members of the Association to make returns to the Secretary of such statistics as may be called for by him, under the direction of any committee duly appointed for the collection of statistics, when not incompatible with private interests.

OFFICERS.

ARTICLE 7. The officers of this Association shall be a President, two Vice-Presidents, nine Directors, a Treasurer, Secretary, and Auditor of Accounts.

ELECTION OF OFFICERS.

ARTICLE 8. At each annual meeting there shall be chosen by ballot a President, two Vice-Presidents and three Directors; the President and Vice-Presidents to serve one year, and the three Directors shall be chosen for terms of three years, unless sooner removed as hereinafter provided.

DUTIES OF OFFICERS.

ARTICLE 9. The President, or in his absence the senior Vice-President present, shall preside at all meetings of the Association and of the Board of Government. All officers shall hold their respective offices until their successors shall be chosen and accept their positions.

ARTICLE 10. The President, Vice-Presidents and Directors shall constitute a Board of Government, and have under their care and direction all matters pertaining to the management of the Association; and five of their number shall constitute a quorum for the transaction of business. Meetings of the board may be called by the President, at such time and place as he may deem expedient, giving each member a written or printed notice of the same at least five days before the day of meeting. At their first meeting the board shall elect a Treasurer, Secretary, and Auditor of Accounts for the year ensuing, and fix the amount of compensation of the Secretary. All vacancies in their board occasioned by death or resignation or removal, shall be filled by the board; and the persons so elected shall hold their offices until the next annual meeting except as hereinafter provided. The board may, from time to time, as they shall deem expedient, appoint committees, from among their own board or from the members at large, to collect statistical information, examine new inventions or processes in manufacturing goods, as also to prepare essays on subjects of interest to the Association.

ARTICLE 11. The Treasurer shall keep a book in which all receipts and payments of money shall be entered, collect all moneys due the Association, and disburse the same upon the written order of the Board of Government. At the annual meeting in each year he shall make an exhibit of his accounts, or oftener if the Board of Government require it. He shall notify the members of assessments voted, and cause them to be collected in a reasonable time.

ARTICLE 12. The Secretary shall attend all meetings of the Association and of the Board of Government, and keep accurate records of their doings. In the absence of the Secretary at any meeting, a Secretary *pro tem.* may be appointed by the presiding officer, who shall be sworn to do all things, while in office, required of the Secretary.

ARTICLE 13. The Auditor shall examine the accounts of the Treasurer annually, and report at each meeting the state of the finances.

ARTICLE 14. Any officer who shall unreasonably absent himself from three consecutive meetings of the Board of Government of which he is a member, or shall otherwise neglect or refuse to perform the duties of his office, may be removed from office at any regular meeting of the Board of Government by a vote of a majority of the members present and voting thereon, a notice of such proposed action to be sent to him by mail at least one week previous to the meeting.

MEETINGS.

ARTICLE 15. The annual meeting of the members of the Association shall be held on the last Wednesday of April, or at such other time, and at such hour and place as the Board of Government may appoint. There shall also be a semi-annual meeting of the Association on the last Wednesday of October, in each and every year, or at such other time, and at such place and hour as the Board of Government may appoint.

Special meetings may be called by the Board of Government whenever they deem it expedient, or upon the written application of any ten members, made to the Secretary.

ARTICLE 16. All meetings of the members of the Association shall be in pursuance of a written or printed notice, addressed to each member, with the name of the President or Secretary attached thereto, and deposited in the Post Office ten days at least before the day of meeting, specifying the time and place of meeting; and at all such meet-

ings fifteen members shall constitute a quorum for the transaction of business.

ARTICLE 17. Amendments to the By-Laws may be made at any stated meeting of the Association by a two-thirds vote; *provided*, notice of such proposed amendment be given in writing at a previous meeting, and also notice be given to each member by the Secretary, of the pendency of such amendment, ten days at least before any such meeting.

AMENDMENT TO CONSTITUTION AND BY-LAWS.

The following amendment was adopted at the seventy-fifth meeting of the Association, September 30, 1903:

"ARTICLE 5. Any active or associate member by the single payment of one hundred dollars shall be exempt from all future payments for dues and shall become a life member having all the privileges of active members.

All moneys thus paid shall be invested as a permanent fund by the Treasurer acting under the direction of the Board of Government, of which the income only shall be subject to appropriation for current expenses.

All articles of the Constitution and By-Laws, beginning with Article 5, shall be increased in number to the next cardinal number."

BOARD OF GOVERNMENT.

1906.

PRESIDENT.

JAMES R. MacCOLL, ... PROVIDENCE, R. I.

VICE-PRESIDENTS.

WILLIAM D. HARTSHORNE, . . LAWRENCE, MASS.
GEORGE A. AYER, ... EASTHAMPTON, MASS.

DIRECTORS.

ROBERT BEATTY, ... PHILADELPHIA, PA.
CHRISTOPHER P. BROOKS, . . . NEW BEDFORD, MASS.
GEORGE OTIS DRAPER, . . . HOPEDALE, MASS.
GEORGE P. GRANT, JR., . . . FITCHBURG, MASS.
FRANKLIN W. HOBBS, . . . BOSTON, MASS.
WILLIAM H. LOFTUS . . . . NEWARK, N. J.
HENRY F. MANSFIELD, . . . UTICA, N. Y.
ROSCOE S. MILLIKEN, . . . NASHUA, N. H.
CHARLES T. PLUNKETT, . . . ADAMS, MASS.

AUDITOR.

C. E. ROBERTS, ... BOSTON, MASS.

SECRETARY AND TREASURER.

C. J. H. WOODBURY, P. O. BOX 3672, BOSTON, MASS.

OFFICE OF THE ASSOCIATION:

ROOM 57, INTERNATIONAL TRUST BUILDING, 45 MILK STREET, CORNER OF DEVONSHIRE STREET, BOSTON, MASS.

OFFICERS OF THE ASSOCIATION,

FROM THE FIRST ORGANIZATION.

PRESIDENTS.

Ezekiel A. Straw,	1865–78
Amos D. Lockwood,	1878–80
John Kilburn,	1880–83
William C. Lovering,	1883–85
Richard Garsed,	1885–86
J. S. Ludlam,	1886–88
Henry F. Lippitt,	1888–89
Walter E. Parker,	1889–92
Robert McArthur,	1892–94
Edw. W. Thomas,	1894–95
A. M. Goodale,	1895–96
Arthur H. Lowe,	1896–97
Russell W. Eaton,	1897–98
Stephen A. Knight,	1898–99
Frederick E. Clarke,	1899–99
D. M. Thompson,	1900–01
Charles H. Fish,	1901–03
H. E. Walmsley,	1903–05
James R. MacColl	1905–

VICE-PRESIDENTS.

Amos D. Lockwood,	1865–77
William A. Burke,	1865–73
John C. Palfrey,	1873–76
Edward Atkinson,	1876–78
A. G. Cumnock,	1877–80
Charles Nourse,	1878–81
William F. Goulding,	1880–83
Richard Garsed,	1881–85
J. S. Ludlam,	1883–86
Walter E. Parker,	1885–89
Richard B. Borden,	1886–88
Arnold B. Sanford,	1888–91
Robert McArthur,	1889–92
Simeon B. Chase,	1891–93
E. W. Thomas,	1892–94
A. M. Goodale,	1893-95
William J. Kent,	1894–97
Fred. C. McDuffie,	1895–00
Henry T. Whitin,	1897–00
C. H. Richardson,	1900–01
George H. Hills,	1900–02
H. E. Walmsley,	1901–03
Alfred E. Adams,	1902–03
James R. MacColl,	1903–05
W. D. Hartshorne,	1903–
George A. Ayer,	1905–

DIRECTORS.

J. S. Davis,	1865–69
Charles Nourse,	1865–78
Phineas Adams,	1865–74
William P. Haines,	1865–69
Thomas J. Borden,	1865–78
Daniel D. Crombie,	1865–68
A. M. Wade,	1868–69
D. J. Johnston,	1869–70
F. E. Clarke,	1869–75
A. G. Cumnock,	1869–77
Cyrus I. Barker,	1875–80
Hervey Kent,	1877–81
David J. Johnston,	1878–82
Walter Paine, 3d,	1878–80
Chas. L. Lovering,	1878–83
Richard Garsed,	1880–81
William H. Jennings,	1880–83
Chas. D. McDuffie,	1881–83
Walter E. Parker,	1881–85
John W. Danielson,	1881–85
William E. Barrows,	1882–83
Rufus A. Maxfield,	1883–86
George W. Weeks,	1883–86
Henry S. Howe,	1883–87
Richard B. Borden,	1883–86
O. S. Brown,	1885–91
Henry F. Lippitt,	1885–88
Wilbur A. Stiles,	1886–88
Robert McArthur,	1886–89
Stephen N. Bourne,	1886–91
John Kilburn,	1870–80
William P. Haines,	1874–78
S. S. Spencer,	1887–90
E. W. Thomas,	1888–92
William W. Whitin,	1888–93
Robert R. Smith,	1889–92
Alfred M. Goodale,	1890–93
William J. Kent,	1891–94
Herman F. Straw,	1891–93
Fred C. McDuffie,	1892–95
George W. Bean,	1892–95
F. M. Messenger,	1893–95
Albert F. Knight,	1893–99
Arthur H. Lowe,	1894–96
Henry T. Whitin,	1894–97
Herbert L. Pratt,	1895–98
Stephen A. Knight,	1895–98
John Eccles,	1895–99
Russell W. Eaton,	1896–97
C. H. Richardson,	1897–00
George H. Hills,	1897–00
John T. Meats,	1898–01
Alfred E. Adams,	1899–02
A. Tenny White,	1899–02
Charles H. Fish,	1900–01
Herbert E. Walmsley,	1900–01
Wm. D. Hartshorne,	1901–03
James R. MacColl,	1901–03
Geo. F. Whitten,	1898–04
W. B. Smith Whaley,	1901–04
J. R. Montgomery,	1902–05
Wm. D. Pennell,	1902–05
George A. Ayer,	1904–05
P. A. Mathewson,	1903–06
George P. Grant, Jr.,	1903–
Christopher P. Brooks,	1904–

DIRECTORS.—Continued.

William H. Loftus,	1905–	George Otis Draper,	1906–
Roscoe S. Milliken,	1905–	Robert Beatty,	1906–
Charles T. Plunkett,	1905–	Henry F. Mansfield,	1906–
Franklin W. Hobbs,	1906–		

AUDITORS.

Benjamin Saunders,	1865–71	J. Herbert Sawyer,	1882–00
John C. Palfrey,	1871–73	C. E. Roberts,	1900–
Henry D. Sullivan,	1873–82		

SECRETARY AND TREASURER.

Ambrose Eastman,	1865–94	C. J. H. Woodbury,	1894–

MEMBERS OF THE ASSOCIATION.

October 1, 1906.

Members of the Association are respectfully requested to scrutinize the following list, and advise the Secretary, P. O. Box 3672, Boston, Mass., of change in address, or any error in regard to their names.

As a number of members rejoined the Association after severing their first membership, the date of their earliest election is given.

HONORARY MEMBERS.

GEORGE ARMS	Grand Hotel	New York City	Oct. 16, 1872.
HENRY SMITH PRITCHETT, LL.D.,	Prest. Mass. Institute of Technology,	Boston, Mass.	Sept. 26, 1901.
EDWARD C. STOKES		Trenton, N. J.,	Sept. 21, 1905.
FRANKLIN P. STOY	817 Pacific Ave.,	Atlantic City,	Sept. 21, 1905.
SAMUEL WEBBER	Hydraulic Engineer	Charlestown, N. H.	Apr. 20, 1865.

LIFE MEMBERS.*

John Ormsbee Ames	Agt. & Sec'y Fletcher Mfg Co., 47 Charles St.,	Providence, R. I.,	Sept. 21, 1905. Sept. 21, 1905.
William Ames	Treas. Fletcher Mfg. Co., P. O. Box 83, 47 Charles St.,	Providence, R. I.,	Apr. 30, 1879. Sept. 21, 1905.
Augustus T. Clark	Treas. American Circular Loom Co.	Chelsea, Mass.	Sept. 21, 1905. Sept. 21, 1905.
Charles H. Fish	Agt. Cocheco Manufg. Co.,	Dover, N. H.,	Apr. 27, 1887. Apr. 28, 1904.
William D. Hartshorne	Agt. Arlington Mills,	Lawrence, Mass,	Apr. 27, 1899. Apr. 26, 1906.
James R. MacColl	Treas. Lorraine Mfg. Co.	Pawtucket, R. I.,	Apr. 24, 1895. Sept. 21, 1905.

* The first date is that of the original election to the Association and the second date that of Life Membership.

John R. Mitchell	Mitchell-Bissell Co.	38 Murray St., New York City	Oct. 18, 1900. Apr. 27, 1905.
Robert W. Neff	Chemical Mfr.,	22 India Sq., Boston, Mass.,	Apr. 24, 1902. Apr. 28, 1904.
Walter E. Parker	Agt. Pacific Mills	217 Haverhill St., Lawrence, Mass.	Apr. 25, 1877. Apr. 27, 1905.
George I. Rockwood	Mech. Eng.	62 Summer St., Worcester, Mass.	Apr. 25, 1901. Apr. 25, 1901.
Robert Schaellibaum	Prest. Robert Schaellibaum Co.	Providence, R. I.	Sept. 22, 1904. Sept. 22, 1904.
C. J. H. Woodbury	Secretary and Treasurer,	51 Baltimore St., Lynn, Mass.,	Oct. 29, 1879. Apr. 28, 1904.

ACTIVE MEMBERS.

Alfred E. Adams	Agt. Whitinsville Cotton Mills Agt. Linwood Mills	Whitinsville, Mass.	Apr. 27, 1887.
Ivers S. Adams	Supt. American Net and Twine Co.	East Cambridge, Mass.	Sept. 22, 1904.
Robert Franklin Adams,	Treas. The Adams Mfg. Co.	106 Grand St., New York, N. Y.	Sept. 22, 1904.
William P. Adams	Supt. Pittsfield Mills,	Pittsfield, N. H.,	Apr. 28, 1904.
James W. Ahmuty	Supt. Atlantic Cotton Mills,	Lawrence, Mass.,	Apr. 28, 1904.
Joseph D. Aiken	Asst. Supt. Ponemah Mills	Taftville, Conn.	Oct. 28, 1891.
F. S. Akin	Supt. Cornell Mills	Fall River, Mass.	Sept. 27, 1894.
Charles T. Aldrich	Treas. Aldrich Mfg. Co.	37 Weybosset St., Box 34, Providence, R. I.	Apr. 28, 1886.
Bradley C. Algeo	Asst. Director Philadelphia Textile School,	Broad and Pine Sts., Philadelphia, Pa.,	Sept. 21, 1905.
John W. Allis	Vice-Prest. and Agt. Utica Knitting Co.,	Utica, N. Y.	Apr. 27, 1905.
George E. Ames	Mech. Supt. Lawrence Mfg. Co.	Lowell, Mass.	Apr. 24, 1895.
Charles B. Amory	Treas. Hamilton Manufg. Co.	70 Kilby St., Boston, Mass.	Apr. 25, 1894.
Frederic Amory	Treas. Nashua Mfg. Co. and Jackson Mfg. Co.	85 Devonshire St., P. O. Box 1302, Boston, Mass.	Apr. 27, 1899.
Joshua D. Armitage	Supt Cloth Dept., Arlington Mills	247 Haverhill St., Lawrence, Mass.	Apr. 26, 1906.
Thomas Armstrong	Supt. No. Pownal Mfg. Co.	No. Pownal, Vt.	Oct. 28, 1897.
Abel T. Atherton	Machine Maker	Longmeadow, R. I.	Oct. 16, 1872.
William F. Arthur	Supt. Nashua Mfg. Co.	Nashua, N. H.	Apr. 23, 1903.
E. W. Atkinson	Stoddard, Haserick, Richards & Co.	152 Congress St., Boston, Mass.	Oct. 27, 1886.
H. C. Atwood	Treas. Williamsville Manufg. Co.	Killingly, Conn.	Apr. 29, 1885.
James A. Atwood	Agt. Wauregan Co. and Quinebaug Co.	Wauregan, Conn.	Oct. 28, 1891.

John Walter Atwood . Supt. Wauregan Co. . . . . Wauregan, Conn. . . Oct. 25, 1895.
W. E. Atwood . . . . Prest. Williamsville Manufg. Co. . . Killingly, Conn. . . . Sept. 27, 1894.
George A. Ayer . . . Supt. West Boylston Co. . . . . Easthampton, Mass. . Apr. 24, 1895.
Nathaniel F. Ayer . . . Asst. Mgr. Farwell Bleachery, ...
. . . . . 10 P. O. Square, Boston, Mass. . . . Apr. 25, 1901.

J. W. Bailey . . . . . Principal, The Bradford Durfee Textile School . . . .
. . . . . Fall River, Mass. . . Apr. 23, 1903.
Dickerson G. Baker . . Mech. Eng., American Thread Co. . . . . .
. . . . . P. O. Box B, Willimantic. Conn. . Oct. 18, 1900.
Edwin H. Baker . . . Bliss, Fabyan & Co., Box 2899 . . . . . .
. . . . . 117 Duane St., New York, N. Y. Apr. 24, 1878.
Wallace L. Ball . . . Agt. Consolidated Cotton Duck Company, Columbia Mills Co.
. . . . . Columbia, S. C. . . Apr. 26, 1906.
Joseph W. Ballard . . Supt. Griswoldville Mfg. Co. . . . . Griswoldville, Mass., Apr. 26, 1906.
Edward R. Ballou . . . Treas. Ballou Yarn Co., ...
. . . . . 189 Charles St., Providence, R. I. . . Apr. 25, 1894.
Frederick D. Ballou . . Supt. W. A. Slater Mills . . . . . Jewett City, Conn. . Apr. 23, 1903.
V. T. Barber . . . . . Supt. Slater Cotton Co., 9 Beech St., Pawtucket, R. I. . . Oct. 2, 1902.
J. E. Barbour . . . . Prest. Barbour Flax Spinning Co. . . . . .
. . . . . 418 Grand St., Paterson, N. J. . . . Apr. 28, 1904.
Louis B. Barker . . . Agt. United States Cotton Co. . . . Central Falls, R. I. . Apr. 27, 1899.
Harold C. Barnefield . Treas. Hays Textile Co. . . . . Pawtucket, R. I. . . Apr. 26, 1906.
Lewis E. Barnes . . . Agt. Pemberton Co. & Methuen Co., Methuen, Mass. . . . Oct. 25, 1895.
William A. Barrell . . Agt. Lawrence Duck Co. . . . . Lawrence, Mass. . . Apr. 30, 1884.
Thomas Barrett, Jr. . . Prest. Langley & Aiken Mills . . . Augusta, Ga. . . . . Apr. 26, 1900.
Edward E. Bartlett . . Supt. Parker Mills, No. 2 . . . . . Warren, R. I. . . . Sept. 22, 1904.
Edwin N. Bartlett . . . Supt. Edwin Bartlett Co., ... North Oxford, Mass. . Apr. 29, 1891.
Daniel Moore Bates . Asst. Supt. Joseph Bancroft & Sons Co., ...
. . . . . Rockford, Wilmington, Del. . . Apr. 27, 1898.
William M. Batt . . . Asst. Treas. The Davol Mills Box 73, Fall River, Mass. . . Apr. 26, 1906.
Joseph P. Battles . . . Treas. The Textile Machinery Speciality Co. . . . . .
. . . . . Lawrence, Mass., . . Oct. 25, 1895.
Edward C. Beach . . Gen. Mgr. Gate City Cotton Mills . East Point, Georgia . Oct. 5, 1899.
C. Enos Bean . . . . Agt. Lawrenceville Mfg. Co. . . . Lawrenceville, Ga. . Apr. 24, 1902.
George W. Bean . . . Agt. Androscoggin Mills . . . . . Lewiston, Me. . . . Apr. 17, 1872.
Robert Beatty . . . . Robert Beatty & Co. . . . . .
. . . . . Coral and Adams Sts., Philadelphia, Pa. . . Oct. 28, 1897.
John W. Bell . . . . . Asst. Treas. and Gen. Mgr. Smith & Dove Manufg. Co. . .
. . . . . Andover Mass. . . . Oct. 28, 1897.
Albert Farwell Bemis . Prest. Jackson Fibre Co., (Jackson, Tenn.) . . . . . .
. . . . . P. O. Box 5173, 89 State St., Boston, Mass. . . . Apr. 23. 1903.
Orin F. Bennett, . . . Supt. Naumkeag Steam Cotton Co. . Salem, Mass. . . . . Sept. 13, 1906.
A. C. Bent . . . . . Agt. Safety Seamless Pocket Co. . . Taunton, Mass. . . . Oct. 28, 1897.
William H. Bilbrough . Mgr. and Treas. Elmira Knitting Mills and Mgr. Conewawah
. . . . . Spinning Co., Elmira, N. Y. . . . . Apr. 24, 1902.

John H. Binns . . . . Supt. Dyeing & Finishing Arlington Mills, Thornfield . . . . . Methuen, Mass. . . Apr. 26, 1906.
John B. Bird . . . . . Engineer Joseph Bancroft & Sons Co. Wilmington, Del. . Apr. 26, 1906.
Robert Bishop . . . . Robert Bishop Mfg. Co. . . . . 157 West 6th St., South Boston, Mass., Apr. 26, 1906.
W. N. Blackstone . . { Treas. Attawaugan Co. / Treas Totokett Mills Co } . . . . Norwich, Conn. . . . Apr. 29, 1896.
Wm. Washington Blades, Gen. Supt. Lorraine Mfg. Co. . . . . 135 Mineral Spring Ave., Pawtucket, R. I. . . Oct. 25, 1893.
Charles Ray Blake . . Asst. Supt. Tremont and Suffolk Mills . . . . . 141 Cabot St., Lowell, Mass., . . . Sept. 21, 1905.
William S. Blakeley . . Prest. The Arashapa Co. . . . . Chester, Pa., ... Sept. 21, 1905.
Edward R. Blanchard . Mgr. Glenlyon Dye Works, Phillipsdale Branch . . . . . 25 Elmgrove Ave., Providence, R. I. . . Apr. 26, 1906.
Robert C. Blood . . . John Blood & Co . . . . . 7th and Somerset Sts., Philadelphia, Pa. . . Apr. 26, 1906.
T. Ashby Blythe . . . Prest. Ashby Cotton Mills, ... 114 Chestnut St., Philadelphia, Pa. . . Oct. 28, 1897.
John P. Bodge . . . . Treas. Arkwright Mills . . . . . Fall River, Mass. . . Oct. 28, 1897.
J. B. Bolton . . . . . Supt. New York Mills . . . . . New York Mills, N. Y. Apr. 26, 1906.
Jefferson Borden, Jr. . Supt. Fall River Bleachery Co. . . . Fall River, Mass. . . Apr. 21, 1899.
Nathaniel B. Borden . Treas. Barnard Manufg. Co. . . . . Fall River, Mass. . . Oct. 15, 1873.
Norman E. Borden . . Sec. Lowell Weaving Co. . . . . Lowell, Mass. . . . Apr. 26, 1906.
Raymond D. Borden . Treas. Watuppa Mills, ... Taunton, Mass. . . . Sept. 22, 1904.
Richard B. Borden . . { Treas. Richard Borden Mfg. Co. / Treas. Troy C. & W. Mfg. Co. . } Fall River, Mass. . July 19, 1865.
E. S. Boss . . . . . Agt. American Thread Co. . . . . Willimantic, Conn. . Oct. 29, 1879.
A. E. Bosworth . . . . Supt. Bernon Mills . . . . . Georgiaville, R. I. . . Oct. 2, 1902.
Henry Deane Bourne . Treas. Hooksett Mfg. Co., ... 1741 Elm St. Manchester, N. H. . Oct. 18, 1900.
Stephen N. Bourne . . Agt. Dundee Mills, Hooksett . . . . . 971 Chestnut St., Manchester, N. H. . Oct. 21, 1868.
Frank A. Bowen . . . Supt. Appleton Co. . . . . Lowell, Mass. . . . Apr. 28, 1897.
William V. Boyd . . . Asst. to Mgr. Canadian Col'd Cotton Mills Co. . . . . P. O. Box 76, Cornwall, Ont. . . . Apr. 26, 1906.
Arthur F. Brackett . . . . . Riverpoint, R. I. . . Oct. 25, 1895.
Albert W. Brainerd . . . . . Box 33, Lawrence, Mass. . . Apr. 27, 1898.
S. Parker Bremer . . . Treas. Monadnock Mills . . . . . 4 Winthrop Sq., Boston, Mass., . . . Oct. 2, 1902.
Ernest Bridge . . . . Supt. Jas. Chadwick & Bro. Ltd. . . Jersey City, N. J. . . Apr. 24, 1895.
Joseph Brierley . . . . Supt. W. C. Plunkett & Sons Warp Mill, ... 33 Summer St., Adams, Mass. . . . Sept. 21, 1905.
George T. Briggs . . . Prest. and Gen. Mgr. The Briggs Mfg. Co. . . . . Voluntown, Conn., . Apr. 24, 1902.
Jas. T. Broadbent . . Instr. Carding and Spinning, Bradford Durfee Textile School, ... Fall River, Mass., . . Apr. 28, 1904.

Joseph H. Bromley . . Manufacturer of Lace Curtains, ...
. . . . . Fourth and Lehigh Ave., Philadelphia, Pa., . . Sept. 21, 1905.
Christopher P. Brooks . Prin. Textile Dept., International Correspondence School, .
. . . . . New Bedford, Mass. Apr. 28, 1897.
Henry R. Brown . . . Supt. Phenix Mill . . . . . Box 56, Phenix, R. I. . . . . Apr. 28, 1897.
Isaac A. Brown . . . . Treas. Narragansett Mills . Box 324, Fall River, Mass. . . Sept. 29, 1898.
Thomas J. Brown . . . George Brown's Sons . . . . . Mt. Joy, Pa. . . . . Oct. 28, 1897.
E. C. Bucklin . . . . Treas. Interlaken Mills . . . . . .
. . . . . Butler's Exchange, Box 289, Providence, R. I. . . Apr. 25, 1883.
Harris H. Bucklin . . Asst. Treas. Interlaken Mills . . . Providence, R. I. . . Apr. 23, 1903.
Granville R. Budlong . Purchasing Agt. Union Wadding Co. Providence, R. I. . . Sept. 21, 1905.
E. R. Bullock, ... Mech. Eng., J. & P. Coats, Ltd., ...
. . . . . 38 Brook St., Pawtucket, R. I. . . Apr. 28, 1904.
Robert Burgess . . . . Treas. Burgess Mills . . . . . Pawtucket, R. I. . . Apr. 27, 1892.
Edward N. Burke . . . Lowell Machine Shop . . . . . .
. . . . . 216 Nesmith St., Lowell, Mass. . . . Apr. 28, 1880.
Alfred H. Burnham . . Mgr. Glasgow Mills, ...
. . . . Orthodox and Horrocks Sts., Frankford, . . Philadelphia, Pa. . . Apr. 26, 1900.
Charles F. Burnham . . Treas. Crefeld Waste and Batting Co., ...
. . . . . and The L. A. Lockwood Co. . . . Saylesville, R. I. . Sept. 21, 1905.
Hervey Burnham . . . Supt. Beaver Mills and Eclipse Mill . . . . . .
. . . . . 234 East Main St., North Adams, Mass. . Apr. 27, 1899.
W. R. Burnham . . . . . 362 Main St., Norwich, Conn. . . . Apr. 29, 1885.
John L. Burton . . . . Supt. Bristol Mfg. Co. . . . . New Bedford, Mass. . Apr. 23, 1903.
Obadiah Butler . . . . Supt. New York Mills Co. . . . . .
. . . . . P. O. Box 14, New York Mills, Oneida County, N. Y. Sept 13, 1906.
Samuel T. Butterworth . Supt. Baltic Mills Co., P. O. Box 103, Baltic, Conn. . . . . Sept. 21, 1905.

William H. Cadwell . . Agt. Jackson Company . . . . . Nashua, N. H. . . . Apr. 26, 1900.
John P. Campbell . . . Asst. Treas. New York Mills, New York Mills, ...
. . . . . Oneida Co., N. Y. . Sept. 22, 1896.
Byron F. Card . . . . Supt. Tallassee Falls Mfg. Co. . Tallassee, Elmore Co., Ga. Apr. 25, 1888.
Stewart F. Carter . . . Superintending Chemist, Atlantic Fibre Co. . . . . .
. . . . . Park Place, Suffern, N. Y. . . . Apr. 26, 1906.
Arnold B. Chace . . . Treas. Valley Falls Co. . . . . Albion, R. I. . . . . Apr. 26, 1906.
Benjamin C. Chace, Jr. . Care Jenckes Spinning Co. . . . . Pawtucket, R. I. . . Sept. 21, 1905.
Malcolm G. Chace . . Prest. Naushon Mfg. Co. . . . . Valley Falls, R. I. . . Sept. 21, 1905.
Alfred M. Chadwick, . Asst. Agt. Tremont & Suffolk Mills, Lowell, Mass. . . . Apr. 28, 1904.
John W. Chafee . . . Prest. and Treas. The Sibley Mfg. Co. Augusta, Ga. . . . . Oct. 18, 1900.
Simeon B. Chase . . . Treas. King Philip Mills . . . . . Fall River, Mass. . . Apr. 21, 1875.
E. G. Chester . . . . Prop. E. G. Chester Hosiery Co. . . . . .
. . . . . Cedar and Huntingdon Sts., Philadelphia, Pa. . . Sept. 21, 1905.
Chas. E. Childs . . . . Treas. Hampton Co., Asst. Treas. West Boylston Co. . . .
. . . . . Easthampton, Mass. . Oct. 1, 1903.
Clarence N. Childs . . Agt. Hamilton Manufg. Co. . . . . .
. . . . . 43 Pine St., Lowell, Mass. . . . Apr. 24, 1895.

Elmer G. Childs . . . Agt. Boston Duck Co. . . . . Bondsville, Mass. . . Oct. 26, 1892.
Jno. H. C. Church . . . Treas. and Gen. Mgr. Monument Mills, Great Barrington Mass. Apr. 28, 1897.
Avery B. Clark, ... Supt. Merrimack Mfg. Co. . . . . Lowell, Mass. . . . Apr. 27, 1905.
Ernest E. Clark . . . Supt. Williamsville Mfg. Co. . . . . Killingly, Conn. . . Apr. 29, 1896.
William Clark . . . . Agt. Wm. Clark Mills, American Thread Co. . . . . Westerly, R. I. . . Sept. 21, 1905.
E. N. Clemence . . . Cotton Manufacturer . . . . . Charlotte, N. C. . . . Apr. 28, 1897.
W. H. Cloher, Jr. . . . Prest. Utica Cotton Co., . Capron, Oneida Co., N. Y., . Sept. 22, 1896.
Alfred M. Coats . . . Gen. Mgr. J. & P. Coats, L't'd. . . . . 13 Brown St., Providence, R. I. . . Sept. 21, 1905.
W. C. Cobb . . . . . Supt. Ware Shoales Mfg. Co. . . . Ware Shoals, S. C. . Apr. 26, 1906.
Josiah G. Coburn . . . . . 99 Washington St., Newton, Mass. . . . Apr. 20, 1865.
Charles H. Collins . . Supt. Berkeley Co. . . . . Ashton, R. I. . . . . Apr. 26, 1900.
John A. Collins . . . . Supt. American Linen Co. . . . . 73 Cottage St., Fall River, Mass. . . Oct. 31, 1883.
Frank B. Comins . . . Treas. American Moistening Co. . . . . 79 Milk St., Room 901, Boston, Mass. . . . . Oct. 28, 1891.
Caesar Cone . . . . . Prest. Proximity Mfg. Co. . . . . Greensboro, N. C. . . Apr. 26, 1900.
William A. Congdon . Agt. Whitman Mills, 720 County St., New Bedford, Mass. Apr. 26, 1906.
John J. Connell . . . . Agt. Tremont & Suffolk Mills . . . Lowell, Mass. . . . Apr. 27, 1892.
Halsey Connett . . . . Supt. Clark Mile End Spool Cotton Co. East Newark, N. J. . Oct. 2, 1902.
Reuben A. Cooke . . . Treas. Queen City Cotton Co. . . . . Lake Side Ave., Burlington, Vt. . . . Sept. 13, 1906.
Robert A. Copeland . . Supt. Yarn Mills, Perry Knitting Co. . . . . P. O. Box 4765, Perry, New York . . Apr. 26, 1906.
Peter H. Corr . . . . Treas. Greenwich Bleachery . . . . Taunton, Mass. . . . Apr. 24, 1895.
Frank H. Cotton . . . . . Fayetteville, N. C . . Apr. 27, 1899.
Lyman M. Cousens, . . Prest. Dana Warp Mills . . . . . Portland, Me. . . . Apr. 24, 1902.
Alphonse S. Covel . . Treas. Tremont and Suffolk Mills, ... P. O. Box 1716, 70 Kilby St., Boston, Mass. . . . Oct. 31, 1877.
Thomas D. Covel . . . Treas. The Covel and Osborne Co. . Fall River, Mass. . . Apr. 26, 1906.
Richard Cowell . . . . . 77 Mt. Pleasant St., New Bedford, Mass. . Apr. 24, 1902.
L. B. Cranska . . . . Floyd Cranska Mills . . . . . Moosup, Conn. . . . Sept. 21, 1905.
William W. Crapo . . Prest. Wamsutta Mills . . . . . New Bedford, Mass. . Sept. 29, 1898.
Mark B. Creed . . . . Supt. 1, 2, 3 Wamsutta Mills . . . New Bedford, Mass. . Oct. 1, 1903.
George Crompton, . . Treas. Wachusett Mills and member firm Crompton-Thayer Loom Co., Worcester, Mass. . . Oct. 28, 1897.
William W. Crosby . . . . . 8 Court St., Woburn, Mass. . . . Sept. 21, 1905.
John B. Cudlip . . . . Mgr. Cornwall & York Cotton Mills Co. . . . . St. John, N. B. . . . Apr. 28, 1897.
H. H. Culver . . . . . Supt. Elizabeth Poole Mills . . . . . 8 Coram St., Taunton, Mass. . . . Apr. 28, 1897.
Henry S. Culver . . . Treas. Westville Cotton Mills . . . Taunton, Mass. . . . Apr. 28, 1897.
A. G. Cumnock . . . . Treas. Appleton Co. . . . Box 2284, Lowell, Mass. . . . July 19, 1865.
Frederick E. Cunneen . Asst. Supt. Seaconnet Mills, . . . Fall River, Mass. . . Apr. 26, 1906.
Andrew J. Currier . . . Supt. Whitman Mill . . . . . New Bedford, Mass. . Apr. 25, 1888.

Philip Dana . . . . . Supt. Dana Warp Mills . . . . . Westbrook, Me. . . Sept. 29, 1898
Woodbury K. Dana . . Treas. Dana Warp Mills . . . . . Westbrook, Me. . . . Apr. 25, 1888.
A. Lockwood Danielson Treas. Slater Cotton Co. . . . . Pawtucket, R. I. . . Sept. 27, 1894.
J. DeForest Danielson { Asst. Treas. Lockwood Co. & Lewiston Bleachery & Dye Works } Providence, R. I. . . Sept. 27, 1894.
John W. Danielson . . Treas. Lockwood Co., Ponemah Mills, Quinebaug Co., Wauregan Co., Lewiston B. & D. Works, Box 900, Providence, R. I. . . July 15, 1868.
Bradford D. Davol . . Prest. Barnard Mfg. Co., P. O. Box 93, Fall River, Mass. . . Apr. 25, 1877.
Albert Deabill . . . . Supt. Lowell Hosiery Co. . . . . Lowell, Mass., . . . Apr. 25, 1901.
Augustus De Cort . . . Treas. De Cort Yarn Co., ... 724 Exchange Building, Boston, Mass. . . . Apr. 26, 1900.
George DeForest . . . Treas. Utica Steam & Mohawk Valley Cotton Mills . . . . . Utica, New York . . Oct. 28, 1897.
George Delano . . . . Supt. Bourne Mills . . . . . Fall River, Mass. . . Apr. 26, 1906.
Henry B. Deming . . Prest. Deming Braiding Co., Box 555, Providence, R. I. . . Apr. 26, 1906.
William P. Dempsey . Treas. and Mgr. Dempsey Bleachery and Dye Works . . . . . Pawtucket, R. I. . . Apr. 28, 1886.
Charles W. Dennett . . Vice Prest. and Gen. Mgr. Hadley Mills, ... So. Hadley Falls, Mass. . Oct. 29, 1890.
Harlan Ingalls Dennett, Supt. Hadley Mills . . . . . South Hadley Falls, Mass. Apr. 27, 1905.
Arthur W. Dennis . . Prest. and Treas. Elmwood Mills . . . . . Dexter, Daboll and Maroney Sts., Providence, R. I. . . Sept. 21, 1905.
Edward P. Dennis . . . . . 50 Chelmsford St., Lowell, Mass. . . . Apr. 25, 1888.
Charles A. Denny . . . . . Leicester, Mass. . . Apr. 25, 1888.
P. Y. DeNormandie . . Treas. Pepperell Mfg. Co. . . . . 30 Kilby St., Boston, Mass. . . . Apr. 29, 1896.
Charles Owen Dexter . Agt. Beacon Mfg. Co. . . . . New Bedford, Mass., Apr. 24, 1895.
George O. Dexter . . . Supt. Canadian Colored Cotton Mills Co. Hamilton, Ont. . Apr. 27, 1905.
Henry C. Dexter, . . . Agt. and Sec. Greene & Daniels Mfg. Co. . . . . Pawtucket, R. I. . . Apr. 25, 1901.
Lewis Dexter, Jr. . . . . 65 La Casas St., Malden, Mass. . . . Apr. 27, 1899.
Albert W. Dimick . . . Agt. Fisher Mfg. Co. . . . . Fisherville, Mass. . . Apr. 25, 1894.
Bradford C. Divine . . Supt. and Mgr. Utica Willowvale Bleaching Co. . . . . Chadwicks, Oneida Co., N. Y. . . Apr. 27, 1899.
Charles S. Doggett . . Director, Textile Dept. Clemson College . . . . . Clemson College, S. C. Apr. 26, 1906.
Robert Dow, ... Partner in Solway Mills, ... Westerly, R. I. . . . April 25, 1901.
Arthur J. Draper . . . { Treas. Hoskins, Louise Calvine and Dover Yarn Mills . . . . . Charlotte, N. C. . . Apr. 23, 1903. Treas. The Pell City Mfg. Co. . . Pell City, Ala. . . . }
Eben S. Draper . . . Agt. Draper Co. . . . . Hopedale, Mass. . . Oct. 31, 1888.
George A. Draper . . . Treas. Draper Co. . . . . Hopedale, Mass. . . Oct. 31, 1888.
George Otis Draper . . Sec'y Draper Co. . . . . Hopedale, Mass. . . Apr. 24, 1895.
William F. Draper . . Prest. Draper Co. . . . . Hopedale, Mass. . . July 17, 1867.
Henry C. Dresser . . . Gen. Supt. Bibb Mfg. Co. . . . . Macon, Ga. . . . . Apr. 27, 1905.
Harry K. Drew . . . Supt. Fulton Bag and Cotton Mills . Atlanta, Ga. . . . . Apr. 24, 1902.
O. D. Drew . . . . . Supt. Dwight Manufacturing Co. . . . . 76 Dwight St., Chicopee, Mass. . . Oct. 2, 1902.

James B. Duggan . . . . . 41 Jewett Place, Utica, N. Y. . . . . Oct. 2, 1902.
Frederic C. Dumaine, . Treas. Amoskeag Mfg. Co., Box 2879 . . . . . .
. . . . . 64 Ames Building, Boston, Mass. . . . April 25, 1901.
Joseph M. Dunham . . . . . 43 Edwards St., Springfield, Mass. . . Oct. 26, 1892.
John H. Dunn . . . . Gen. Supt. Tremont & Suffolk Mills Lowell, Mass. . . . Oct. 1, 1903.
Frank J. Dutcher . . . Asst. Agt. Draper Co. . . . . Hopedale, Mass. . . Apr. 24, 1902.
Frank H. Dwelly . . . Treas. Tecumseh Mills . . . . . Fall River, Mass. . . Apr. 27, 1899.
David H. Dyer . . . . D. H. Dyer & Son, Mill Engineers, P. O. Box 582, . . .
. . . . . 6, 7 and 8 Pocassett Bank Building, Fall River, Mass. . . Oct. 18, 1871.

Benjamin M. Earle . . Prop. Merchants Dye Works . . . . East Dedham, Mass. Sept. 26, 1901.
Wm. Ambrose Eastman, Gen. Mgr. Hooper Knitting Co. . . Lowell, Mass. . . . Apr. 24, 1878.
Russell W. Eaton . . . Agt. Cabot Manufg. Co. . . . . Brunswick, Me. . . . Oct. 27, 1887.
John Eccles . . . . . Agt. Ponemah Mills . . . . . Taftville, Conn. . . . Apr. 27, 1892.
Jesse P. Eddy, Jr., . . Asst. Treas. Tillinghast Stiles Co., and Prest. and Treas.
. . . . . Fitch Mfg. Co., P. O. Box 1566, Providence, R. I. . . Sept. 21, 1905.
Oscar Elsas . . . . . Vice-Prest. Fulton Bag & Cotton Mills, ...
. . . . . P. O. Box 773, Atlanta, Ga. . . . . Apr. 28, 1897.
William E. Elsberry . . Sec'y and Treas. Tallassee Falls Mfg. Co. . . . . .
. . . . . Tallassee, Ala. . . . Sept. 13, 1906.
Frederick W. Ely . . . Agt. Columbian Manufg. Co. . . . Greenville, N. H. . . Apr. 25, 1888.
H. B. Estes . . . . . Agt. Continental Mills . . . . . Lewiston, Me. . . . Apr. 26, 1893.
John H. Estes . . . . Cotton Manufacturer . . . . . Fall River, Mass. . . Apr. 23, 1903.
James C. Eteson . . . Supt. Orswell Mills, ... Fitchburg, Mass. . . Sept. 22, 1904.
William Evans . . . . Gen. Supt. Hargraves & Parker Mills, ...
. . . . . 295 Winter St., Fall River, Mass. . Apr. 29, 1896.
D. A. Everly . . . . . 371 Broadway, Pawtucket, R. I. . . Apr. 24, 1902.

Charles F. Farrar . . . . . 49 Coggeshall St., Fall River, Mass. . . Oct. 28, 1897.
George E. Farrell . . . Sec. Ontario Knitting Co. and Standard Yarn Mills, . . .
. . . . . Oswego, N. Y. . . . Oct. 18, 1900.
James T. Ferguson . . Supt. Warwick Mills . . . . . Centreville, R. I. . . Oct. 5, 1899.
John A. Fernley . . . Supt. Butler Mill . . . . . New Bedford, Mass. . Sept. 22, 1904.
Frank S. Field . . . . Asst. Treas. Massaemit Yarn Mills . Shattuckville, Mass. . Oct. 25, 1895.
Eugene Finocchiaro . . . . . 532 Broadway, Chelsea, Mass. . . . Apr. 28, 1904.
William Firth . . . . Prest. American Moistening Co. & Wm. Firth Co. . . . .
. . . . . 79 Milk St., Boston, Mass. . . . Apr. 25, 1888.
George Fish . . . . . Supt. Massachusetts Cotton Mills, . Lowell, Mass. . . . Apr. 27, 1905.
Charles W. Fisher . . Asst. Supt. Fisher Mfg. Co. . . . . Fisherville, Mass. . . Apr. 25, 1901.
Henry E. Fisher . . . Vice-Prest.&Treas. Atlanta Cotton Mills, Atlanta, Ga. . . . . Oct. 25, 1895.
Frederick A. Flather . Treas. Boott Mills, . . 79 Milk St., Boston, Mass. . . . . Apr. 29, 1891.
F. C. Fletcher . . . . Vice Prest. Lawton Spinning Co. . . . . .
. . . . . 621 Banigan Building, Providence, R. I. . . Oct. 18, 1900.
Benjamin Forster . . . Supt. Weaving, I. E. Palmer Mill . . . . . .
. . . . . 384 Main St., Middletown, Conn. . Apr. 26, 1906.

Henry J. Forsyth	Supt. Cooleemee Cotton Mill,	Cooleemee, N. C.	Oct. 1, 1903.
John W. Foster	Asst. Supt. Print Works, Hamilton Mfg. Co.	Lowell, Mass.	Apr. 26, 1906.
M. F. Foster		Milford, N. H.	Apr. 17, 1872.
Edward W. France	Dir. of Philadelphia Textile School,	320 So. Broad St., Philadelphia, Pa.	Sept. 22, 1896.
John W. France	Supt. The Aberfoyle Mfg. Co., and the Galey & Lord Mfg. Co.	427 East Broad St., Chester, Pa.	Sept. 21, 1905.
Arthur C. Freeman	Textile Finishing Machinery Co.	17 Exchange Place, Providence, R. I.	Apr. 27, 1899.
Simon Friedberger	Prest. Friedberger-Aaron Mfg. Co.	Germantown, Logan Station, Philadelphia, Pa.	Apr. 23, 1903.
John W. Fries	Managing Partner, F. & H. Fries & Prest. Arista Mills Co.	Winston-Salem, N.C.,	Oct. 18, 1900.
C. H. Frisbie	Agt. Attawaugan Co.	Norwich, Conn.	Oct. 29, 1890.
Hachiro Henry Fukuhara,	Supt. Sumoto Mill, Kanegafuchi Spinning Co.	Hiogo, Japan,	Apr. 28, 1904.
S. L. Gabriel	Treas. United States Linen Co.	Taunton, Mass.	Sept. 22, 1904.
W. T. Galey	Prest. Aberfoyle Manufg. Co.	Chester, Pa.	Apr. 28, 1897.
William Gammell	Agt. Berkeley Co.	Providence, R. I.	Oct. 28, 1885.
Arnold C. Gardner	Treas. Manomet Mills, 76 Bedford St.,	New Bedford, Mass.	Apr. 26, 1906.
James G. Garland	Prest. The Garland Mfg. Co.	Saco, Me.	Oct. 29, 1879.
William H. Garner	Agt. Newmarket Mfg. Co.	Newmarket, N. H.	Sept. 22, 1904.
Edward T. Garsed		Charlotte, N. C.	Apr. 27, 1898.
Walter R. Garsed	Mgr. Wingohocking Cotton Mills	Frankford, Philadelphia, Pa.	Oct. 1, 1903.
E. Stanley Gary	Vice Prest. and Gen. Mgr. Gary Mfg. Co.	724 Equitable Bldg. Baltimore, Md.	Oct. 1, 1903
James A. Gary	Prest. Gary Mfg. Co.	720–724 Equitable Bldg., Baltimore, Md.	Apr. 25, 1883.
James Gee	Supt. Interlaken Dye Works	Fiskville, R. I.	Apr. 27, 1898.
Charles E. Getchell	Prest. Waltham Emery Wheel Co.	115 Bacon St., Waltham, Mass.	Oct. 30, 1889.
R. H. I. Goddard Jr.,	Goddard Bros.	Providence, R. I.	Apr. 27, 1905.
William C. Godfrey	Agt. Indian Orchard Co.	Indian Orchard, Mass.	Oct. 29, 1890.
Otto Goetze,	Partner and Treas. Glasgow Mills, Orthodox and Horrocks	Sts., Frankford, Philadelphia, Pa.	Apr. 24, 1902.
Lyman B. Goff	Prest. Union Wadding Co.	Pawtucket, R. I.	Sept. 21, 1905.
Alfred M. Goodale	Cloth & Yarn Broker	40 State St., Boston, Mass.	Apr. 25, 1883.
C. B. Gordon	Vice Prest. Dominion Textile Co., Ltd.	112 St. James St. Montreal, P. Q. Canada	Sept. 13, 1906.
Frederick B. Gordon	Prest. Columbus Mfg Co.	Columbus, Ga.	Apr. 26, 1900.
Charles H. Gorton	Aragon Mills	Aragon, Ga.	Apr. 25, 1894.
Marcellus Gould	Prest. and Mgr. N. H. Spinning Mills,	Penacook, N. H.	Sept. 22, 1896.
J. Whidden Graham	Supt. St. Croix Mill, Canadian Col'd Cotton Mill Co.	Milltown, New Brunswick	Apr. 26, 1906.

George P. Grant, Jr. . . Treas. Grant Yarn Co. . . . . Fitchburg, Mass. . . Sept. 27, 1894.
D. W. Gray . . . . . Manager La Tosca Spinning Co., . . Utica, N. Y. . . . . Oct. 26, 1892.
R. A. Gray . . . . . Supt. Rodman Manufg. Co. . . . . Allenton, R. I. . . . Apr. 24, 1895.
Edwin Farnham Greene, Asst. Treas. Dwight Mfg. Co. & Prest. Lockwood, Greene & Co.
. . . . . Boston, Mass. . . . Apr. 24, 1902.
Joseph Warren Greene . Sec'y Hamilton Web Co. . . . . Hamilton, R. I. . . . Apr. 29, 1896.
William C. Greene . . Treas. Peace Dale Manufg. Co. . . Peace Dale, R. I. . . Oct. 27, 1886.
John T. Greenwood . . R. Greenwood & Bault . . . . . .
. . . . . 4720 Leiper St., Frankford, Philadelphia, Pa. . . Apr. 26, 1900.
S. Greenwood . . . . Mgr. Canadian Col'd Cot. Mills Co. Ltd. . . . . .
. . . . . Cornwall, Ontario . . Oct. 5, 1899.
William K. Greer . . . Asst. Supt. Eclipse & Beaver Mills . . . . . .
. . . . . P. O. Box 258, North Adams, Mass. Apr. 26, 1906.
John Gregson . . . . Agt. Fiskdale Mills . . . . . Fiskdale, Mass. . . . Apr 24, 1895.
Maxwell Grierson . . . Gen. Mgr. Jas. Chadwick & Bro., Ltd., Jersey City, N. J. . . Apr. 27, 1898.
Adam H. Groel . . . Supt. Clark Mile End Spool Cotton Co. East Newark, N. J. . Sept. 21, 1905.
David Grove . . . . . Supt. U. S. Cotton Co. . . . . Central Falls, R. I. . Apr. 27, 1898.
George W. Grove . . . Treas. Argo Mills Co. . . . . Gloucester City, N. J. Sept. 21, 1905.
Henry S. Grove . . . Prest. Argo Mills Co., ...
. . . . . 318 Marine and Merchant Bldg., Philadelphia, Pa. . . Apr. 27, 1898.
Louis I. Guion . . . . Supt. Columbia Mills Co., Box 130 . Columbia, S. C. . . . Oct. 2, 1902.
Percy Gulline . . . . Supt. Merrimack Print Works, ...
. . . . . 197 Pawtucket St., Lowell, Mass. . . . Sept. 21, 1905.
Arthur H. Gulliver . . . . . P. O. Box 313, Norwich Town, Conn. Apr. 24, 1889.
Frank B. Gustafson . . Asst. Mgr. I. E. Palmer Cotton Spinning Mill . . . . .
. . . . . Middletown, Conn. . Apr. 26, 1906.

William J. Hadfield . . Harrison & Gore Silk Mills . . . . . .
. . . . . 124 Smith St., Newburgh, N. Y. . . Apr. 27, 1899.
Frank J. Hale . . . . Gen. Agt. Saco and Pettee Machine Shops . . . . . .
. . . . . Newton Upper Falls, Mass. . Apr. 27, 1892.
Walter B. Hall . . . . Supt. Hamilton Mfg. Co. . . . . Lowell, Mass. . . . . Apr. 25, 1901.
William E. Hall . . . Treas. and Mgr. Shaw Stocking Co., Lowell, Mass. . . . Apr. 27, 1892.
Z. D. Hall . . . . . Supt. Berkshire Cotton Mfg. Co. . . . . .
. . . . . 70 Orchard St., P. O. Box 963, Adams, Mass. . . . Oct. 29, 1879.
William Halliwell . . . Mgr. Ingrahamville Dye Works . Pawtucket, R. I. . . Sept. 21, 1905.
William Halliwell, . . Agt. Providence and Woonsocket Mills of the Lawton Spin-
. . . . . ning Co., Woonsocket, R. I. . Sept. 26, 1901.
Alton L. R. Hambly, . Supt., Quidnick Mfg. Co. . . . . Quidnick, R. I. . . Apr. 26, 1906.
John H. Hambly . . . Treas. Quidnick Manufg. Co. . . . . .
. . . . . 49 Westminster St., Providence, R. I. . . Apr. 24, 1895.
Maylin Hamburger . . Gen. Mgr. Rockfall Mills, Rockfall, Conn. and . . . .
. . . . . Montgomery Mills, ... North Wales, Pa. . . Sept. 21, 1905.
Arthur M. Hamilton . . . . . 267 Hanover St., Fall River, Mass. . . Apr. 28, 1897.
John F. Hamlet . . . Manufacturer . . . P. O. Box 160, Fall River, Mass. . . Oct. 31, 1888.

Peter Hardman . . . Supt. American Thread Co., Willimantic Mills . . . . . .
. . . . . 137 South Main St., Willimantic, Conn. . Apr. 23, 1903.
A. G. Harris . . . . . West Warren Cotton Mills, ... West Warrren, Mass. Sept. 26, 1901.
Henry F. Harris . . . Treas. West Boylston Manufg. Co. . . . . .
. . . . . 340 Main St., Worcester, Mass. . . Apr. 30, 1890.
Charles E. Harrison . . Mgr. Harrison Yarn & Dyeing Co. Pawtucket, R. I. . . Sept. 22, 1904.
W. G. Hartford . . . Treas. & Mgr. Monarch Woolen Mills Montville, Conn. . . Apr. 23, 1903.
Frank Hartley . . . . Supt. S. Slater & Sons, Inc. Print and Dye Works . . . .
. . . . . Webster, Mass, . . . Apr. 27, 1905.
Walter M. Hastings . . Asst. Agt. Arlington Mills . . . . . Lawrence, Mass. . . Apr. 23, 1903.
Chester D. Hatch . . Agt. Exeter Mfg. Co., ... Exeter N. H. . . . . Apr. 28, 1904.
William E. Hatch . . Prest. New Bedford Textile School, ...
. . . . . 166 William St., New Bedford, Mass. . Sept. 22, 1904.
William Hathaway . . Supt. Barnard Manufg. Co. . . . . Fall River, Mass. . . Apr. 25, 1894.
William B. Hawes . . Yarn Broker . . . 108 Bedford St., ...
. . . . . P. O. Box 733, Fall River, Mass. . . Apr. 24, 1895.
Alfred Hawkesworth . Alfred Hawkesworth & Sons Co., Ltd. . . . . .
. . . . . 551 St. James St., Montreal, P. Q. . . . Apr. 26, 1893.
Fred Hawkesworth . . Alfred Hawkesworth & Sons Co., Ltd. . . . . .
. . . . . 551 St. James St., Montreal, P. Q. . . . Sept. 22, 1896.
Charles Hayes, Jr. . . Supt., Skenandoa Cotton Co. . . . Utica, N. Y . . . . Apr. 26, 1906.
William Hayes . . . . Agt. Barker Mill . . . . . Auburn, Me. . . . . Apr. 30, 1879.
William P. Heineken . Gen'l Mgr. and Sec'y Union Mf'g. and Power Co. . . . .
. . . . . Union, S. C. . . . . Apr. 26, 1906.
W. G. Henderson . . . Agt. Falls Co. . . . . Norwich, Conn. . . . Apr. 29, 1896.
A. E. Henry, ... Mfr. Partner in Solway Mills, . . . Westerly, R. I. . . . Apr. 25, 1901.
James Henry . . . . . Thos. Henry & Sons . . . . . .
. . . . . Trenton Ave. and Tioga St., Philadelphia, Pa. . . Oct. 1, 1903.
William G. Henry . . Thos. Henry & Sons . . . . . .
. . . . . Trenton Ave. and Tioga St., Philadelphia, Pa. . . Oct. 1, 1903.
Arthur N. Hersom, . . Supt. Mt. Vernon Mills . . . . . Baltimore, Md. . . . Apr. 28, 1904.
Ernest L. Hersom . . Supt. Nockedge Mills 40 Mechanic St., Fitchburg, Mass. . . Apr. 23, 1903.
T. I. Hickman, ... Prest. and Treas. Graniteville Mfg. Co. . . . . .
. . . . . Leonard Bldg., Augusta, Ga. . . . . Apr. 25, 1901.
Hiram Higham . . . . Supt. 4 and 5 Wamsutta Mills . . . New Bedford, Mass. . Oct. 1, 1903.
William H. Hill . . . Prest. Renfrew Mfg. Co., ...
. . . . . 50 Congress St., Room 810, Boston, Mass. . . . Apr. 24, 1902.
George H. Hills . . . Treas. Davol Mills & Stevens Mfg. Co., Fall River, Mass. . . Oct. 25, 1895.
Alexander F. Hobbs . . Resident Mgr. U. S. Finishing Co . . Providence, R. I. . . Apr. 27, 1905.
Franklin W. Hobbs . . Treas. Arlington Mills . . . . . .
. . . . . P. O. Box 5317, 78 Chauncy St., Boston, Mass. . . . Apr. 27, 1899.
William Henry Hobbs . Asst. Supt. Johnson & Johnson Co., New Brunswick, N. J. Apr. 24, 1902.
Clark W. Holcomb . . Treas. Old Colony Mills, Taunton, ...
. . . . . P. O. Box 5, New Bedford, Mass. . Sept. 21, 1905.
Charles M. Holmes . . Agt. Manomet Mills, ...
. . . . . Box 96, New Bedford, Mass. . Apr. 27, 1899.
Gideon F. Holmes . . Treas. and Gen. Mgr. Plymouth Cor- . . . . . .
. . . . . dage Co. . . . . No. Plymouth, Mass. . Oct. 30, 1889.

George W. Holt . . . Agt. Monohansett Manufg. Co. . . Putnam, Conn. . . . Oct. 29, 1879.
John H. Holt . . . . Supt. Luther Mfg. Co. . . . . Fall River, Mass. . . Apr. 23, 1903.
Walter L. Holt . . . . Prest. Holt-Morgan Mills . . . . . Fayetteville, N. C. . . Oct. 18, 1900.
William P. Holt . . . . . 158 Jackson St., Fall River, Mass. . . Oct. 25, 1893.
Robert P. Hooper . . Treas. Hooper Sons Mfg. Co., ... 509 Arch St., Philadelphia, Pa. . . Sept. 21, 1905.
Wm. E. Hooper . . . Mgr. Woodberry Div. of Mt. Vernon Woodberry Co. . . . . 15 East Franklin St., Baltimore, Md. . . . Apr. 23, 1903.
H. B. Hopson . . . . Supt. Spool Cotton Dept., Bibb Mfg. Co. . . . . Box 98, Macon, Ga. . . . . Apr. 28, 1904.
Edward W. Houghton Supt. Globe Mill, . . Manville Co., Woonsocket, R. I. . Apr. 24, 1902.
Henry S. Houghton, Jr. . . . . 124 Lincoln St., Worcester, Mass. . . Apr. 24, 1895.
W. C. Houston . . . . Prest. Hope Mills Manufg. Co. . . . . 333 Drexel Building, Philadelphia, Pa. . . Apr. 28, 1897.
Henry S. Howe . . . . Dry Goods Commission . . . . . 89 Franklin St., Boston, Mass. . . Oct. 31, 1877.
Albert C. Hoy . . . . Grosvenor Dale Co., . P. O. Box 872, Providence, R. I. . . Apr. 27, 1898.
Charles W. Hubbard . Treas. and Sec. Ludlow Mfg. Associates . . . . . 133 Essex St., Boston, Mass. . . . Apr. 25, 1901.
Otis L. Humphrey, . . Harding, Whitman, & Co., 78 Chauncy St., Boston, Mass. Apr. 25, 1901.
Arthur W. Hunking . Engineer-in-charge, Stone & Webster, St. Croix Falls, Wis. . Apr. 24, 1895.

D. Edwin Irving . . . Treas. The Irving & Leiper Mfg. Co., Chester, Pa. . . . . Oct. 28, 1897.

P. T. Jackson, Jr. . . . Treas. Lowell Weaving Co. . . . . Lowell, Mass. . . . Sept. 21, 1905.
Joseph B. Jamieson . . Prest. Holmes Knitting Co. . . . . 77 Summer St., Room 80, Boston, Mass. . . . Oct. 2, 1902.
Earl S. Jenckes . . . . Supt. Paul Whitin Mfg. Co. . . . . Northbridge Mass. . Apr. 27, 1905.
J. E. Jenckes . . . . . Treas. E. Jenckes Manufg. Co. & E. Jenckes Spinning Co. . . . . Pawtucket, R. I. . . Apr. 24, 1895.
Edward B. Jennings . . Treas. Samoset Co. & Agt. Allen Ptg. Co., Providence, R. I. . . . . Valley Falls, R. I. . Sept. 29, 1898.
David L. Jewell . . . . . 48 Grand View Ave., Wollaston, Mass., . Apr. 20, 1865.
W. H. Jillson . . . . Mfr. Cotton Yarns . . . . . Westfield, Mass. . . Apr. 26, 1906.
Leonard Johnson . . . Supt. Page Mfg. Co. . . 9 Allen St., New Bedford, Mass. . Oct. 1, 1903.
David S. Johnston . Gen. Supt. Harmony Mills . . . . Cohoes, N. Y. . . . Oct. 28, 1891.
Gordon A. Johnstone . Agt. Danielson Cotton Co. . . . . Danielson, Conn. . . Apr. 23, 1903.
W. T. Jordan . . . . Mgr. Mountain Island Mfg. Co. . . Mountain Island, N. C. Oct. 25, 1895.

Nelson D. Keables . . Mech. Supt., Mass. Cotton Mills . . . . . 14 Hoyt Ave., Lowell, Mass. . . . Apr. 26, 1906.
W. E. Keach . . . . . Supt. Grant Yarn Co., 21 Burnap St., Fitchburg, Mass. . . Oct. 26, 1892.
Roland R. Kelly . . . Supt. Williamstown Manufg. Co. . Williamstown Sta., Mass. Nov. 30, 1881.
Nathaniel B. Kerr . . . Treas. Butler Mill . . . . . New Bedford, Mass. . Oct. 26, 1892.

Harry W. Kimball . . . . . Bath, Me. . . . . Oct. 25, 1895.
William N. Kimball . . Supt. Social and Nourse Mills, Manville Co. . . . . .
. . . . . Woonsocket, R. I. . . Apr. 24, 1902.
Robert F. Kineavy . . Supt. Arasapha Mfg. Co. . . . . Chester, Pa. . . . . Sept. 21, 1905.
Alexander King, Jr. . . Asst. Supt. American Thread Co. . . Westerly, R. I. . . Apr. 27, 1905.
Emil Kipper . . . . . Prest. Blackington Mfg. Co. of Blackington . . . . . .
. . . . . Adams, Mass. . . . Apr. 24, 1902.
John T. Kirk . . . . . Supt. Weaving Slater Cotton Co., Box 697 . . . . . .
. . . . . Pawtucket, R. I. . . Apr. 27, 1905.
Albert F. Knight . . . Mfr. Fine White Cotton Goods and Yarns . . . . . .
. . . . . 1149 Elmwood Ave. Box 835, Providence, R. I. . . Oct. 27, 1886
Jesse A. Knight . . . . Asst. Treas. and Supt. Argo Mills Co. Gloucester City, N. J. Oct. 26, 1892.
Stephen A. Knight . . Prest. Hebron Manufg. Co.; Box 820, Providence, R. I. . . Oct. 21, 1868.
Walter B. Knight . . . Supt. The Windham Mfg. Co. . . . Willimantic, Conn. . Apr. 24, 1889.
Webster Knight . . . B. B. & R. Knight's Mills . . . . . .
. . . . . 3 Washington Row, Providence, R. I. . . Oct. 31, 1888.
John Kniveton . . . . Instr. Weaving and Warp Preparation, ...
. . . . . Bradford Durfee Textile School, Fall River, Mass., . . Sept. 22, 1904.
John W. Knowles . . . Treas. Page Mfg. Co. . . . . New Bedford, Mass. . Sept. 13, 1906

Fred Lacey . . . . . Supt. Boott Mills . . . . . Lowell, Mass. . . . Apr. 24, 1895.
Elliott Cowdin Lambert, Supt. Amoskeag Manufg. Co. . . . Manchester, N. H. . Oct. 25, 1895.
William T. Lang . . . Agt. Brookside Mills . . . . . Knoxville, Tenn. . . Apr. 28, 1897.
Walter H. Langshaw · Agt. Dartmouth Manufg. Corp. . . New Bedford, Mass. . Apr. 29, 1896.
Harold Lawton . . . . Treas. & Gen. Mgr. The Lawton Mills, Corp. . . . . .
. . . . . Plainfield, Conn. . . Oct. 27, 1886.
John Edward Lawton . Governing Director American Thread Co., ...
. . . . . Matlock, Derbyshire, England . Apr. 25, 1901.
Calvin H. Lee . . . . Supt. Readville Cotton Mills . . . Hyde Park, Mass. . . Apr. 24, 1902.
Evan Arthur Leigh . . Textile Machinery 232 Summer St., Boston, Mass. . . . . Oct. 29, 1890.
J. Colby Lewis . . . . Agt. Salmon Falls Mfg. Co. . . . . Salmon Falls, N. H. . Oct. 26, 1892.
Charles F. Libby . . . Supt. Shaw Stocking Co. . . . . Lowell, Mass. . . . Apr. 24, 1902.
Leontine Lincoln . . . Prest. Seaconnet Mills . . . . . Fall River, Mass. . . Apr. 28, 1897.
B. F. G. Linnell . . . Commission Merchant, Yarns, Threads and Twines . . .
. . . . . 37 Summit St., P. O. Box 645, Central Falls, R I. . . Oct. 28, 1897.
Henry F. Lippitt . . . Gen. Mgr. Manville Cos., P.O. Box 139, Providence, R. I. . . Apr. 27, 1881.
L. A. Lockwood . . . { Prest. Crefeld Waste & Batting. Co. & The L. A. Lockwood Co. } Saylesville, R. I. . Sept. 21, 1905.
William H. Loftus . . Supt. Clark Thread Co. . . . . Newark, N. J. . . . Oct. 28, 1897.
Oliver N. Long . . . . Long Bros. Co. . 3d and Ontario Sts., Philadelphia, Penn. . Sept. 13, 1906.
Harry D. Lord . . . . Selling Agt. Saco and Pettee Machine Shops . . . . . .
. . . . . 244 Main St., Biddeford, Me. . . . Apr. 27, 1905.
Hartley L. Lord . . . Gen. Mgr. Union-Buffalo Mills Co. . Union, S. C. . . . . Apr. 26, 1906.
John T. Lord, ... Supt. Pacific (Lower) Mills . . . . Lawrence, Mass. . . Apr. 28, 1904.
Robert W. Lord . . . Prest. & Treas. R. W. Lord & Co. . Kennebunk, Me. . . Oct. 20, 1869.

Ernest Lovering	Agt. Lyman Mills	Holyoke, Mass.	Apr. 25, 1888.
Henry M. Lovering	Asst. Treas. Whittenton Manufg. Co.	Taunton, Mass.	Oct. 27, 1880.
William C. Lovering	Prest. Whittenton Manufg. Co.	50 State St., Boston, Mass.	Oct. 25, 1876.
William M. Lovering	Lawrence & Co.,	24 Thomas St. New York, N. Y.	Sept. 27, 1894.
Arthur H. Lowe	Treas. Parkhill Mfg. Co., Treas. Wm. Lowe Mfg. Co., Huntsville, Ala.	Fitchburg, Mass.	Oct. 30, 1889.
David Lowe	Supt. Parkhill Manufg. Co.	Fitchburg, Mass.	Apr. 24, 1895.
Charles B. Luther	Treas. Luther Mfg. Co.	240 Hartwell St., P. O. Box 57, Fall River, Mass.	Sept. 22, 1904.
Dudley T. Lyall		Delhi, Delaware, County N. Y.	Sept. 22, 1896.
William L. Lyall	Treas. Brighton Mills	Passaic, N. J.	Oct. 26, 1892.
Herbert Lyman		39 Beacon St., P. O. Box 1717, Boston, Mass.	Oct. 25, 1895.
Ronald T. Lyman	Treas. Boston Mfg. Co.	P. O. Box 1717, Boston, Mass.	Oct. 1, 1903.
Alvin S. Lyon	Agt. Wood Worsted Mill	Lawrence, Mass.	Apr. 26, 1882.

W. H. Macdonald	Asst. Supt., St. Croix Mill, Canadian Col'd Cotton Mill Co.,	Milltown, New Brunswick	Apr. 26, 1906.
Charles L. Macomber	Prest. Winthrop Cotton Yarn Co.	Taunton, Mass.	Apr. 24, 1895.
Frederick B. Macy,	Treas. Soule Mills,	New Bedford, Mass.	Apr. 25, 1901.
Amos G. Maddox	Supt. Linwood Cotton Mill	Linwood, Mass.	Oct. 18, 1900.
Charles T. Main	Mech. and Mill Engineer, Dean & Main	53 State St., 1112 Exchange Bldg., Boston, Mass.	Oct. 28, 1885.
Alexander Makepeace	Supt. Richard Borden Mfg. Co.	Fall River, Mass.	Oct. 1, 1903.
Charles R. Makepeace	Mill Engineer	Box 973, Providence, R. I.	Apr. 30, 1890.
Vladimir Malinin, M. E.,	Prochoroff Three Hill Mfg. Co.	Moscow, Russia	Apr. 23, 1903.
J. D. Mallory	Supt. John M. Stone Cotton Mill	Starkville, Miss.	Apr. 27, 1905.
Fred B. Manley	Treas. Spencer Yarn Co.	Adamsdale, Mass.	Apr. 26, 1906.
Arthur B. Mann	J. H. Martin & Co., 99 Franklin St.,	New York, N. Y.	Apr. 25, 1894.
Charles H. Manning	Supt. Amoskeag Manufg. Co.	Manchester, N. H.	Oct. 28, 1885.
Henry F. Mansfield	Gen. Supt. Utica Steam Cotton Mills and Mohawk Valley Cotton Mills	Utica, N. Y.	Apr. 30, 1890.
Paul J. Marrs	Treas. Henderson Cotton Mills	Henderson, Ky.	Oct. 28, 1897.
Henry D. Martin	Gen. Supt. Lancaster Mills	Lancaster, Mass.	Apr. 28, 1897.
Arthur H. Mason	Treas. Davis Mills	Fall River, Mass.	Oct. 2, 1902.
Frederick R. Mason	Prest. and Treas. The Robert D. Mason Co.	Pawtucket, R. I.	Sept. 21, 1905.
Philip A. Mathewson	Supt. King Philip Mills	Box 607, Fall River, Mass.	Apr. 24, 1895.
Scott Maxwell,	Agt. Indian Head Mills of Ala.	Cordova, Ala.	Sept. 26, 1901.
Thomas Mayor	Textile Machinery	Thomas Mayor & Son, 26 Olney St., Providence, R. I.	Oct. 27, 1880.
Andrew W. McAllister		Natick, R. I.	Apr. 28, 1904.
Robert McArthur	Agt. Pepperell Mfg. Co.	Biddeford, Me.	Apr. 17, 1872.

Thos. McAuliffe	Supt. Stevens Mfg Co.	Fall River, Mass.	Apr. 27, 1898.
Edward J. McCaughey	Sec'y Home Bleach & Dye Works	106 Spring St., Pawtucket, R. I.	Apr. 26, 1906.
Fred C. McDuffie	Treas. Everett Mills and York Mfg. Co., P. O. Box 2934	24 Milk St., Boston, Mass.	Oct. 25, 1882.
Robert P. McEwen	Supt. Lambeth Rope Corp.	64 Willis St., New Bedford, Mass.	Apr. 26, 1906.
John G. McFadden	Supt. Natick Mills	Natick, R. I.	Oct. 1, 1903.
David H. McKinley	Prop. Philadelphia Thread Co.	Hancock and Oxford Sts., Philadelphia, Pa.	Sept. 21, 1905.
James A. McLane	Supt. Davis Mills	Fall River, Mass.	Oct. 2, 1902.
William G. McLoon		Clinton, Mass.	Apr. 27, 1892.
R. P. McLoughlin	Asst. Treas. and Asst. Mgr. La Tosca Yarn Mill	Utica, N. Y.	Sept. 13, 1906.
Robert G. McMeehan,	Agt. Uncasville Mfg. Co.	Uncasville, Conn.	Sept. 26, 1901.
William P. McMullan	Agt. Naumkeag Steam Cotton Co.	Salem, Mass.	Sept. 27, 1894.
John Tempest Meats	Agt. Mason Machine Works	Taunton, Mass.	Apr. 27, 1887.
Robert B. Meikle	Supt. Lorraine Mfg. Co.	Westerly, R. I.	Apr. 23, 1903.
Henry P. Meikleham,	Agt. Mass. Mills in Georgia	Lindale, Floyd Co., Ga.	Apr. 26, 1900.
Joseph Mercer	Agt. and Treas. Willimantic Cotton Mills Co.	Willimantic, Conn.	Apr. 24, 1902.
Charles H. Merriman, Jr.	Manville Co., Board of Trade Bldg.,	Providence, R. I.	Apr. 24, 1895.
James G. Merriam, Jr.	Mgr. Standard Spinning Co.	Oswego, N. Y.	Sept. 21, 1905.
Joseph Merriam	Prest. Springfield Webbing Co.	Middletown, Conn.	Oct. 2, 1902.
R. M. Miller, Jr.	Prest. & Treas. Elizabeth Mills	Charlotte, N. C.	Sept. 29, 1898.
Simon Miller	Member Firm Jacob Miller Sons & Co.,	Borich Mills, 16th & Reed Sts., Philadelphia, Pa.	Apr. 26, 1906.
Almon A. Milliken	Supt. The Jackson Co.	Nashua, N. H.	Sept. 21, 1905.
James I. Milliken	Agt. Everett Mills	Lawrence, Mass.	Oct. 26, 1892.
Roscoe S. Milliken	Agt. Nashua Mfg. Co.	Nashua, N. H.	Apr. 29, 1896.
David Milne	C. J. Milne & Sons	Washington Ave. & 10th and 11th Sts., Philadelphia, Pa.	Apr. 28, 1897.
A. B. Mole	Gen. Mgr. Dominion Cotton Mills Co.	210 Milton St., Montreal, P. Q.	Apr. 24, 1895.
Edward A. Mongeon	Supt. Lonsdale Mills	Lonsdale, R. I.	Apr. 24, 1895.
George M. Montgomery	Vice Prest. The J. R. Montgomery Co.	Windsor Locks, Conn.	Sept. 22, 1904.
J. R. Montgomery	Prest. The J. R. Montgomery Co.	Windsor Locks, Conn.	Sept. 29, 1898.
George A. Moody	Supt. West Warren Cotton Mills	West Warren, Mass.	Apr. 27, 1899.
Fred W. Moore	Agt. Cordis Mills	P. O. Box 582, Millbury, Mass.	Apr. 27, 1892.
William F. Morgan	Treas. & Gen. Mgr. Fitchburg Duck Mills	Fitchburg, Mass.	Apr. 26, 1906.
George B. Morison	Prest. Ballou Yarn Co.,	77 Summer St., Boston, Mass.	Apr. 24, 1895.
Albert H. Morton	Supt. Lowell Machine Shop	Lowell, Mass.	Oct. 28, 1891.
E. P. Morton,	Agt. Stevens Linen Works	Webster, Mass.	Sept. 26, 1901.
Harold Mowry	Mgr. Sterling Branch U. S. Finishing Co.	Sterling, Conn.	Apr. 27, 1905.
Farquharson J. Muir	Cone Export & Commission Co.	Greensboro, N. C.	Apr. 27, 1892.

William Myers . . . . Lecturer in Textiles, Sunny Bank, ... Stone Edge, Marple, Cheshire, England . . . . . Sept. 22, 1904.

John Neild . . . . . Agt. Grinnell Mfg. Corp. . . . . New Bedford, Mass. . Apr. 25, 1901.
Will Nelson . . . . . Head Instructor of Weaving, Lowell Textile School . . . . . Lowell, Mass. . . . Apr. 23, 1903.
Roscius C. Newell . . . Supt. Palmer Mill, Otis Co. . . . . Three Rivers, Mass. . Oct. 25, 1895.
H. W. Nichols . . . . Supt. New Bedford Textile School . New Bedford, Mass. . Sept. 22, 1904.
William A. Nichols . . Mill Supt. . . . . 120 Pine St., Fall River, Mass. . . Apr. 26, 1906.
William G. Nichols . . Gen. Res. Agt. China, Webster & Pembroke Mills . . . . . Suncook, N. H. . . . Oct. 25, 1893.
Albert W. Noone, . . . Prop. & Mgr. Jos. Noone's Son's Co. Peterl oro, N. H. . . Sept. 26, 1901.
Franklin Nourse . . . Agt. Lawrence Manufg. Co. . . . . Lowell, Mass. . . . Apr. 24, 1878.

S. Odenheimer . . . . Prest. Lane Maginnis Mills . . . . New Orleans, La. . . Oct. 25, 1893.
Charles K. Oliver . . . Prest. U. S. Duck Corporation . . Baltimore, Md. . . . Sept. 27, 1894.
Louis Atwell Olney . . Prof. Chemistry & Dyeing, Lowell Textile School . . . . . Lowell, Mass. . . . Apr. 26, 1906.
William B. Orr, ... Treas. Forestdale Mfg. Co. . . . . Forestdale, R. I. . . Apr. 28, 1904.
Henry Osgood, ... 6 Monroe St., P. O. Box 204. Salem, Mass. . . . . Apr. 25, 1901.
Frederick Ott . . . . Supt. Lehigh Valley Silk Mills . . . South Bethlehem, Pa. Apr. 23, 1903
Herbert W. Owen . . Supt. Cocheco Mfg. Co. . . . . Dover, N. H. . . . . Oct. 5, 1899.
Logan Owen . . . . Supt. Mill No. 1, Bibb Mfg. Co., . . Macon, Ga. . . . . Apr. 28, 1904.
Oscar L. Owen . . . . Mech. and Mill Eng. Whitin Machine Works . . . . . P. O. Box 168, Whitinsville, Mass. . Apr. 25, 1894.

Elmer E. Page . . . . Agt. York Manufacturing. Co. . . . Saco, Me. . . . . Apr. 27, 1892.
Calvin D. Paige . . . Treas. Central Mills . . . . . Southbridge, Mass. . Apr. 26, 1906.
Walter H. Paige . . . Supt. Wamsutta Mills Nos. 6 & 7 . . New Bedford, Mass. . Oct. 1, 1903.
O. B. Parker . . . . . Supt. Quidnick Mfg. Co. . . . . Quidnick, R. I. . . . Apr. 24, 1895.
Samuel L. Parker . . . Supt. Turners Falls Cotton Mills . . . . . Box 627, Turners Falls, Mass. . Apr. 29, 1896.
Winthrop Parker . . . Supt. Queen City Cotton Co. . . . . 54 Bay View St., Burlington, Vt. . . . Sept. 13, 1906.
Samuel F. Patterson . . Prest. and Treas. Thistle Mills Co. . Ilchester, Md. . . . Oct. 18, 1900.
Arthur H. Paul . . . . Asst. Supt. Boston Mfg. Co. . . . . Waltham, Mass. . . . Apr. 27, 1905.
John W. Pead . . . . . 1072 Bridge St., Lowell, Mass. . . . . Apr. 26, 1893.
James R. Pearce . . . Supt. Pell City Mfg. Co. . . . . Pell City, Ala. . . . Oct. 25, 1895.
William E. Peck . . . Agt. The Baltic Mills Co. . . . . Baltic, Conn. . . . . Apr. 26, 1906.
H. M. Peirce . . . . . Agt. Greenwich Bleachery . . . . East Greenwich, R. I. Apr. 26, 1906.
William C. Peirce . . . Pres. Elizabeth Mills . 564 Eddy St., Providence, R. I. . . Apr. 24, 1895.
William D. Pennell . . Agt. Hill Manufg. Co. . . . . Lewiston, Me. . . . Apr. 16, 1873.
Haven C. Perham . . . Treas. Kitson Machine Co. . . . . Lowell, Mass. . . . Apr. 30, 1879.
Charles W. Perkins . . Supt. Totokett Mfg. Co. . . . . Versailles, Conn. . . Sept. 21, 1905.

Hadley D. Perkins . . Mgr. Bellingham H'dk'f Mfg. Co., R. F. D. No. 1 . . . .
. . . . . Woonsocket, R. I. . Apr. 28, 1904.
Aaron C. Phelps . . . Vice Prest. & Gen. Mgr. German-American Co. . . . . .
. . . . . Spray, N. C. . . . . Apr. 26, 1906.
Henry C. Phillips . . . Asst. Gen. Supt. Harmony Mills . . Cohoes, N. Y. . . . Apr. 25, 1894.
Albert R. Pierce . . . Supt. Pierce Mfg. Corp. . . . . New Bedford, Mass. . Oct. 5, 1899.
Andrew G. Pierce, Jr. . Treas. Pierce Manufg. Corp. . . . . .
. . . . . P. O. Box 34, New Bedford, Mass. . Apr. 24, 1895.
Robert Place . . . . . Supt. Flint Mills, Fall River, Mass., Corr Mills, Taunton,
. . . . . Mass., ... 212 Weybosset St, Fall River, Mass. . . Apr. 26, 1906.
Charles H. Plummer . . Agt. Great Falls Manufg. Co., . . . Somersworth, N. H. Apr. 25, 1888.
Charles T. Plunkett . . Sec. Berkshire Cotton Mfg. Co. . . Adams, Mass. . . . Apr. 28, 1897.
William B. Plunkett . . Treas. Berkshire Cotton Mfg. Co. and Greylock Mills . .
. . . . . Adams, Mass. . . . Sept. 21, 1905.
William C. Plunkett . . Mgr. W. C. Plunkett & Sons . . . Adams, Mass. . . . Oct. 1, 1903.
Frank Porter, Jr. . . . Supt. Danielson Cotton Mill . . . . Danielson, Conn. . . Apr. 26, 1906.
Charles H. Potter, . . . Supt. Montreal Cotton Co., ... Valleyfield, P. Q., . . Apr. 25, 1901.
Joseph H. Potter, Jr. . Supt. Durfee Mills . . . . . Fall River, Mass. . . Apr. 27, 1899.
J. F. Powers . . . . . Supt. Spinning Mill . . . . . Middletown, Conn. . Oct. 5, 1899.
Lavater W. Powers . . Gen. Supt. New York Mills . . . . . .
. . . . . New York Mills, Oneida County, N. Y. Oct. 1, 1903.
Albert S. Pratt . . . . Agt. Edwards Mfg. Co. . . . . Augusta, Me. . . . . Apr. 27, 1905.
Herbert L. Pratt . . . Agt. Bates Manufg. Co. . . . . Lewiston, Me. . . . Oct. 27, 1875.
George E. Prest . . . 9 Russell St. . . . . Melrose, Mass. . . . Apr. 24, 1902.
John E. Prest . . . . 9 Russell St. . . . . Melrose, Mass. . . . Apr. 17, 1872.

F. J. Quinn . . . . . Agt. Hamilton Woolen Co. . . . . Amesbury, Mass. . . Apr. 26, 1906

Theodore Ellis Ramsdell, Gen. Supt. Monument Mills . . . . Housatonic, Mass. . Apr. 23, 1903.
M. A. Rawlinson . . . Agt. Chicopee Mfg Co. . . . . Chicopee Falls., Mass. Apr. 24, 1895.
Joseph G. Ray . . . . Treas. The Putman Mfg. Co. . . . Woonsocket, R. I. . . Sept. 13, 1906.
Charles O. Read . . . Mgr. Sayles' Bleacheries, and Treas. Glenlyon Dye Works
. . . . . 63 Summit St. Pawtucket, R. I. . . Sept. 21, 1905.
John F. Reardon . . . Supt. Millville Mfg. Co. . . . . Millville, N. J. . . . Apr. 26, 1900.
Robert Redford . . . . . Box 28, Lawrence, Mass. . . Apr. 26, 1882.
R. S. Reinhardt . . . . Treas. and Mgr. Elm Grove Cotton Mills . . . . . .
. . . . . Lincolnton, N. C. . Apr. 27, 1898.
T. H. Rennie . . . . . Supt. Graniteville Mfg. Co. . . . . Graniteville, S. C. . . Oct. 18, 1900.
William H. Rennie . Supt. Warren Mfg. Co. . . . . Warrenville, S. C. . . Apr. 26, 1906.
Robert Reoch . . . . Gen. Mgr. Cranston Print Works Co. Phenix, R. I. . . . Sept. 21, 1905.
Frederic W. Reynolds, Supt. Potomska Mills, Corp. . . Box 299, ...
. . . . . 53 Fourth St., New Bedford, Mass. . Apr. 26, 1900.
Francis H. Rice . . . . Prest. Holbrook Mills . . . . . Millbury, Mass. . . . Apr. 28, 1880.
John Bion Richards . . Treas. Davis Mills . . . . . Fall River, Mass. . . Apr. 24, 1902.

Charles H. Richardson Agt. Lancaster Mills . . . . . Clinton, Mass. . . . Apr. 24, 1889.
Harry J. Ricketson, . . Supt. Merchants' Mfg. Co. . . . . Fall River, Mass., . Apr. 28, 1904.
Walter Rigby . . . . Bibb Mfg. Co. . . 3163 First Ave., Columbus, Ga. . . . Apr. 26, 1900.
Charles E. Riley . . . C. E. Riley & Co. . . . . .
. . . . . 65 Franklin St., Box 2815, Boston, Mass. . . . Apr. 25, 1888.
Benj. H. Roberts . . . General Mill Supplies 163 Grove St., Fall River, Mass. . . Apr. 26, 1900.
George W. Robertson . Supt. Dan River Cotton Mills . . . Danville, Va. . . . . Apr. 26, 1906.
Charles D. Robinson . Supt. Crompton Co. . . . . Crompton, R. I. . . . Sept. 27, 1894.
William H. Robinson . Supt. No. 3 Harmony Mill . . . . Cohoes, N. Y. . . . Apr. 24, 1902.
John J. Rooney . . . Asst. Supt. Tremont & Suffolk Mills . . . . . .
. . . . . 151 Cabot St., Lowell, Mass. . . . Apr. 27, 1905.
W. H. Rose . . . . . Sec'y & Treas. Richland, Granby and Olympia Cotton Mills
. . . . . Columbia, S. C. . . . Oct. 18, 1900.
Israel P. Rounds . . . Supt. Naushon Co., 20 Maynard St., Pawtucket, R. I. . . Apr. 26, 1906.
Henry Rowe . . . . . Supt. Elk Mountain Bleachery . . . Asheville, N. C. . . Apr. 28, 1904.
Lewis H. Russell . . . . . Norfolk St. and Sussex Ave., Newark, N. J. . . . Apr. 27, 1905.

Alfred Sagar . . . . . Supt. Arlington Cotton Mills . . . . . .
. . . . . 6 Stevens St., Methuen, Mass. . . Apr. 24, 1902.
Edward H. Sanborn . . Vice Prest. Cold Spring Bleaching and Finishing Works .
. . . . . 305 Betz Bldg., Philadelphia, Pa. . . Oct. 18, 1900.
J. N. Sanderson . . Agt. Renfrew Mfg. Co., ... Adams, Mass., . . . Apr. 28, 1904.
Arnold B. Sanford . . Prest. Kennebec Spinning Mills . . . . . .
. . . . . 67 Chauncy St., Boston, Mass. . . . Oct. 25, 1882.
Pardon B. Sanford . . Supt. Yarn Dept. Utica Knitting Co., Utica, N. Y. . . . . Oct. 2, 1902.
J. Herbert Sawyer . . . . . 84 State St., Boston, Mass. . . . July 19, 1865.
Frank A. Sayles . . . Prop. Sayles Bleacheries, Prest. Lorraine Mfg. Co. . . .
. . . . . Pawtucket, R. I. . . Apr. 26, 1906.
Arnold Schaer . . . . Agt. Warren Manufg. Co. . . . . Warren, R. I. . . . Apr. 24, 1895.
Albert E. Schofield . . Treas. Delph Spinning Co. . . . . .
. . . . . Clearfield and C Sts., Philadelphia, Pa. . . Oct. 1, 1903.
Theodore C. Search . . Prest. Cold Spring Bleaching and Finishing Works . . .
. . . . . Yardley, Pa. . . . . Oct. 18, 1900.
Albion K. Searls . . . Supt. Yarn Dept., Oneita Knitting Mills . . . . . .
. . . . . 195 Elizabeth St., Utica, N. Y. . . . . Apr. 24, 1902.
Charles M. Sears . . . Supt. Harmony Grove Mills, . . . Commerce, Ga. . . . Apr. 27, 1898.
George H. Shapley . . Treas. Silver Lake Co., 78 Chauncy St. . . . . .
. . . . . Boston, Mass. . . . . Apr. 29, 1896.
Frank P. Sheldon . . . Mill Engineer and Architect, 49 Westminster St. . . . . .
. . . . . Industrial Trust Bldg. Providence, R. I. . . Apr. 25, 1894.
Thomas C. Sheldon . . . . . 8 School St., Fitchburg, Mass. . . Oct. 29, 1884.
Charles W. Shepard . . Mgr. Alton Mfg. Co. . . . . Alton, R. I. . . . . Sept. 21, 1905.
Willis S. Shepard . . . V. P. American Net and Twine Co. . . . . .
. . . . . 375 Atlantic Ave., Boston, Mass. . . . Apr. 29, 1896.
William F. Sherman . . Mill Engineer . . . 294 Washington St., Boston, Mass. . Apr. 15, 1874.

Charles M. Shove	Treas. Granite Mills	Box 45, Fall River, Mass.	Oct. 27, 1875.
W. Frank Shove	Treas. Pocasset Mfg. Co., Fall River Mfg Co., Fall River, Mass. and Windham Mfg. Co., Willimantic, Conn.	Fall River, Mass.	Sept. 22, 1904
Herbert H. Shumway		Taunton, Mass.	Apr. 26, 1893.
Francis H. Silsbee	Supt. Cotton Dept. Pacific Mills	Lawrence, Mass.	Apr. 7, 1887.
Nathaniel G. Simonds	Treas. Naumkeag Steam Cotton Co.,	Salem, Mass.	Apr. 27, 1898.
Louis Simpson	Gen. Mgr. Montreal Cotton Co.	Valleyfield, P. Q.	Apr. 24, 1895.
John Skinner	Asst. Treas. West Boylston Mfg. Co.,	Easthampton, Mass.	Apr. 26, 1906.
Abbott E. Slade	Treas. Laurel Lake Mills	863 High St., Fall River, Mass.	Oct. 25, 1893.
Archer J. Smith	Treas. The American Mills Co.	Waterbury, Conn.	Apr. 26, 1906.
Arthur T. Smith	Supt. Langley Manufg Co. Supt. Aiken Manufg. Co.	Langley, S. C.	Oct. 25, 1895.
Charles S. Smith	Mgr. Smith Webbing Co.	Pawtucket, R. I.	Sept. 21, 1905.
James Herbert Smith	Supt. Quinebaug Co.	Danielson, Conn.	Apr. 27, 1898.
Joel Smith	1311 Woodlawn Ave.	Augusta, Ga.	Oct. 25, 1895.
J. C. Smith	Supt. Chace Mills	Fall River, Mass.	Oct. 28, 1897.
John William Smith	Gen. Mgr. T. I. Birken & Co.	Chester, Pa.	Sept. 21, 1905.
Stephen E. Smith	Instr. Cotton Spinning, Lowell Textile School,	Lowell, Mass.	Apr. 27, 1905.
Thomas Henry Smith	Jamestown Cotton Mill	Jamestown, N. Y.	Apr. 30, 1884.
W. H. Smith	Supt. American Textile Co.	Pawtucket, R. I.	Sept. 21, 1905.
Rufus A. Soule	Prest. Soule Mill & City Mfg. Corp.	New Bedford, Mass.	Apr. 28, 1904.
Rufus A. Soule Jr.	Treas. Taber Mill	New Bedford, Mass.	Apr. 26, 1906.
William S. Southworth	Agt. Mass. Cotton Mills	Box 1230, Lowell, Mass.	Oct. 31, 1888.
Antonio Spencer	Prest. Spencer Yarn Co.	337 Butler Exchange, Providence, R. I.	Sept. 21, 1905.
Wilton H. Spencer	Textile Manuf.,	7 Exchange Pl., Providence, R. I.	Apr. 27, 1898.
George E. Spofford	Supt. Blackstone Mfg. Co.	Blackstone, Mass.	Apr. 29, 1896.
Alban Spooner	Prest. Beverly Underwear Co.	Beverly, N. J.	Sept. 21, 1905.
Henry B. Sprague	Treas. Boston Woven Hose and Rubber Co.	Lynn, Mass.	Oct. 5, 1899.
Leroy Springs	Prest. Lancaster Cotton Mills	Lancaster, S. C.	Oct. 25, 1895.
George R. Stearns	Prest. and Treas. Riverside Mills	Augusta, Ga.	Apr. 30, 1890.
Willard W. Stearns	Supt. Nos. 1 & 3 Farr Alpaca Co.	224 Pine St., Holyoke, Mass.	Sept. 13, 1906.
T. B. Stevenson	Supt. Manchaug Co.	Manchaug, Mass.	Apr. 26, 1900.
Robert Stewart	Asst. Supt. Lonsdale Co.	Ashton, R. I.	Apr. 27, 1899.
Samuel Stewart	Supt. Boston Duck Co	Bondsville, Mass.	Apr. 23, 1903.
William J. Stewart	Supt. S. Slater & Sons, Inc.	Webster, Mass.	Apr. 23, 1903.
Walter F. Stiles	Treas. Orswell Mills	Fitchburg, Mass.	Oct. 25, 1895.
O. W. Stites	Supt. Louisville Cot. Mills Co.	Louisville, Ky.	Oct. 25, 1895.
B. L. Stowe	Vice-Prest. Eureka Fire Hose Co.	Wilkinson and Arlington Aves., Jersey City, N. J.	Sept. 26, 1901.
Herman F. Straw	Agt. Amoskeag Manufg. Co. & Manchester Mills.	Manchester, N. H.	Oct. 28, 1885.

John Sullivan . . . . Care C. E. Riley, & Co., ...
. . . . . 65 Franklin St. Boston, Mass. . . . Apr. 27, 1899.
Timothy Sullivan . . . Supt. Stafford Mills . . . . . Fall River, Mass. . . Apr. 27, 1899.
Walter H. Summersby . Agt. Atlantic Cotton Mills . . . . Lawrence, Mass. . . Oct. 25, 1893.
Paul E. Sutro . . . . E. Sutro & Son . . . . . .
. . . . . Thomas & Clearfield Sts., Philadelphia, Penn. . Sept. 13, 1906.
James O. Sweet . . . . Agt. and Treas. Ashland Cotton Co. Jewett City, Conn. . Apr. 28, 1886.

Frederic Taber . . . . Prest. Taber Mill . . . . . New Bedford, Mass. Apr. 26, 1906.
William C. Taber . . . Treas. Whitman Mills and Prest. Beacon Mfg. Co. . . . .
. . . . . New Bedford, Mass. Sept. 21, 1905.
Charles A. Tabor . . . Supt. Thorndike Co. . . . . Thorndike, Mass. . . Apr. 27, 1905.
Robert W. Taft . . . . Treas. Coventry Co. and Bernon Mills . . . . . .
. . . . . Box 1144, Providence, R. I. . . Sept. 27, 1894.
James W. Taylor . . . Care of James E. Mitchell . . . . . .
. . . . . 185 Summer St., Boston, Mass. . . . Oct. 26, 1892.
Samuel Taylor . . . . Supt. Soule Mill . . . . . New Bedford, Mass. . Oct. 1, 1903.
W. Marshall Taylor . . Agt. Indian Orchard Flax Co. . . . . .
. . . . . North Brookfield, Mass. . . Sept. 22, 1896.
Edward Thayer . . . . Sec'y Lebanon Mill Co. . . . . Pawtucket, R. I. . . Sept. 21, 1905.
S. Willard Thayer . . . Treas. Dexter Yarn Co. . . . . Pawtucket, R. I. . . Sept. 26, 1901.
Berton A. Thissell . . Supt. Boott Cotton Mills . . . . . .
. . . . . 47 Mt. Vernon St., Lowell, Mass. . . . Oct. 1, 1903.
Earl A. Thissell . . . . Treas. Lowell Hosiery Co. . . . . Lowell, Mass. . . . Oct. 30, 1878.
Ariel C. Thomas . . . Agt. Boott Cotton Mills . . . . . .
. . . . . 62 Mt. Vernon St., Lowell, Mass. . . . Oct. 31, 1888.
Charles E. Thomas . . . . . 44 Prospect St., Woonsocket, R. I. . . Oct. 31, 1883.
Edward W. Thomas . . Gen. Mgr. Consolidated Cotton Duck Co. . . . . .
. . . . . 809 Continental Trust Bldg., Baltimore, Md. . . . Apr. 30, 1884.
James O. Thompson, Jr. Supt. Wampanoag Mills . . . . . Fall River, Mass. . . Oct. 18, 1900.
Charles R. Thomson . Supt. Renfrew Mfg. Co. . . . . Adams, Mass. . . . Apr. 27, 1905.
Ralph E. Thomson . . Supt. Parkhill Manufg. Co., Mill C. Fitchburg, Mass. . . Apr. 25, 1894.
T. W. Tillar . . . . . Treas. The Ashby Cotton Mill Co., Inc. Emporia, Va. . . . Sept. 21, 1905.
R. Irving Tobey . . . . . Lonsdale, R. I. . . . Oct. 2, 1902.
W. O. Todd . . . . . Sec. and Treas. Lawton Spinning Co. Box 1125, ...
. . . . . 621 Banigan Building, Providence, R. I. . . Oct. 18, 1900
James P. Tolman . . . Prest. Samson Cordage Works . . . . . .
. . . . . 88 Broad St., Boston, Mass. . . . Oct. 29, 1890.
Daniel A. Tompkins . Prest. and Eng. D. A. Tompkins Co. Charlotte, N. C. . . . Oct. 25, 1895.
M. J. Toohey . . . . Mfr. Rope, Twine and Banding . . . . . .
. . . . . 809 Stafford Rd., Fall River, Mass . . Oct. 2, 1902.
George W. Towne . . . Mgr. Bibb Mfg. Co. Columbus Mill Columbus, Ga. . . . Oct. 26, 1892.
Edward B. Townsend, . Treas. Warwick Mills, ...
. . . . . 27 Kilby St., Boston, Mass. . . . Apr. 25, 1901.
George M. Traber . . Mgr. The Perry Knitting Co. . . . Perry, N. Y. . . . . Sept. 13, 1906.

D. Irving Trainer . . . Agt. Lincoln Mfg. Co. . . . . Chester, Pa. . . . . Apr. 23, 1903.
Robert B. Treat . . . . Prest. and Treas. Manufacturers Fuel Co. of Rhode Island .
. . . . . 1032 Banigan Bldg., Providence, R. I. . . Sept. 27, 1894.
W. S. Trickett . . . . Supt. Attawaugan Co. . . . . Montville, Conn. . . Sept. 21, 1905.
C. H. Truesdell . . . . Supt. Attawaugan Co. . . . . Killingly, Conn. . . Oct. 29, 1884.
Edmund E. Truesdell . Supt. China, Webster & Pembroke Mills, ...
. . . . . Suncook, N. H. . . . Apr. 26, 1876.
Oscar B. Truesdell . . . . . 18 Washington Terrace, Newtonville, Mass. . Oct. 15, 1873.
Frank S. Tucker . . . Salesman, Westinghouse Elec. & Mfg. Co. . . . . .
. . . . . 507 Trust Bldg., Charlotte, N. C. . . . Apr. 26, 1906.
George E. Tucker . . . Agt. Otis Co. . . . . Ware, Mass. . . . . Oct. 25, 1895.
Philip S. Tuley . . . Prest. and Treas. Louisville Cotton Mills Co. . . . . .
. . . . . McHenry St., Louisville, Ky. . . . Oct. 18, 1900.
Harry Tunstall . . . . Supt. Wm. Clark Mills American Thread Co. . . . . .
. . . . . Westerly, R. I. . . . Sept. 21, 1905.
George W. Turner . . Supt. Argo Mills Co. . . . . Gloucester City, N. J. Apr. 26, 1900.
William L. Turner . . Prest. North American Lace Co. . . . . .
. . . . . Eighth and Allegheny Ave., Philadelphia, Pa. . . Sept. 21, 1905.
William D. Twiss . . . Supt. Everett Mills . . . . . Lawrence, Mass. . . April 29, 1896.

Fenwick Umpleby . . Instr. Lowell Textile School . . . . Lowell, Mass. . . . Apr. 27, 1905.
Fred Unger . . . . . Supt. I. E. Palmer Mills . . . . . Middletown, Conn . Apr. 26, 1906.
Frederick A. Upham . Asst. Supt., Palmer Mill of the Otis Co. Three Rivers, Mass. . Sept. 13, 1906.
Charles T. Upton . . . . . 63 Mt. Vernon St., Lowell, Mass. . . . Apr. 28, 1897.

George A. Vaughan . . Supt. The Putnam Manufg. Co. . . Putnam, Conn. . . . Sept. 22, 1896.
William P. Vaughan . Agt. Putnam Manufacturing Co. . . . . .
. . . . . 1041 Banigan Building, Providence, R. I. . . Sept. 29, 1898.
Frank P. Vogl . . . . Agt. Monadnock Mills . . . . . Claremont, N. H. . . Sept. 27, 1894.

Jude C. Wadleigh . . . Agt. Merrimack Mfg. Co. . . . . Lowell, Mass. . . . Oct. 26, 1892.
Herbert E. Walmsley . Agt. Wamsutta Mills . . . . . New Bedford, Mass. . Oct. 29, 1890.
Robinson Walmsley . . Supt. Tecumseh Mills, P. O. Box 246, Fall River, Mass. . . Apr. 27, 1899.
Frederick T. Walsh . . Mgr. Thomas Leyland & Co., Dyestuffs, etc. . . . . .
. . . . . 195 Nesmith St., Lowell, Mass. . . . Apr. 28, 1897.
Joseph Wasserman . . Prest. Philadelphia Tapestry Mills, ...
. . . . . Allegheny Ave. and Front St. Philedelphia, Pa. . . Apr. 26, 1906.
Frederick E. Waterman Treas. Stafford Mills & Cornell Mills, Fall River, Mass. . . Sept. 22, 1904.
Joseph Watters . . . . Supt. Osborn Mills . . . . . Fall River, Mass. . . Oct. 15, 1873.
F. E. Wattles . . . . Agt. Boscawen Mills . . . . . Penacook, N. H. . . Oct. 5, 1899.
Wm. T. Westerman . . Mgr. Ontario Spinning Co. . . . . .
. . . . . 1729 Philip St., Philadelphia, Pa. . . Oct. 1, 1903.

W. B. Smith Whaley . Mechanical & Mill Engineer, ... 1012 Tremont Bldg., Boston, Mass. . . . Apr. 24, 1895.
Walter Whipple . . . Supt. Monadnock Mills . . . . . Claremont, N. H. . . Sept. 13, 1906.
Channing Whitaker . . Infringement and Patentability of Inventions . . . . . Lowell Machine Shop . . . . . Lowell, Mass. . . . Oct. 15, 1873.
James L. Whitaker . . Mgr. William Whitaker & Sons . . . . . 308 Mariners and Merchants Bldg., Third and Chestnut Sts., Philadelphia, Pa. . . Sept. 21, 1905.
A. Tenny White . . . Supt. Manville Co. . . . . Manville, R. I. . . . Oct. 27, 1887.
Alphonso F. White . . Supt. Forestdale Mfg. Co., ... Forestdale, R. I. . . Apr. 24, 1902.
W. T. Whitehead . . . Mgr. Dominion Textile Co. . . . . Montreal P. Q., Canada, Apr 26, 1906.
Arthur F. Whitin . . . Prest. Saunders Cotton Mills . . . Whitinsville, Mass. . Apr. 24, 1895.
Fred B. Whitin . . . . Agt. Uxbridge Cotton Mills . . . . North Uxbridge, Mass., Apr. 28, 1897.
Henry T. Whitin . . . Treas. Paul Whitin Manufg. Co. . . Northbridge, Mass. . Apr. 25, 1877.
James Earle Whitin . . Treas. Uxbridge Cotton Mills . . . North Uxbridge, Mass., Apr. 23, 1903.
Paul Whitin . . . . . Asst. Treas. Paul Whitin Mfg. Co. . Northbridge, Mass. . Oct. 1, 1903.
Clarence Whitman . . Treas. Wilkesbarre Lace Mfg. Co. . . . . 39–41 Leonard St., New York City . . . Apr. 26, 1906.
William Whitman . . Prest. Arlington Mills, 78 Chauncy St. . . . . P. O. Box 100, Essex St. Station, Boston, Mass. . . . . Apr. 25, 1901.
William S. Whitney . . Supervising Engineer, American Woolen Co. . . . . Lawrence, Mass. . . Apr. 24, 1878.
Arthur Whittam . . . Care James E. Mitchell Co. . . . . 73 Leonard St., New York, N. Y. . . Apr. 27, 1898.
George F. Whitten . . . . . Manchester, N. H. . Oct. 26, 1892.
John H. Whitten . . . Agt. Stark Mills . . . . . Manchester, N. H. . Apr. 27, 1898.
W. R. B. Whittier . . Mgr. Whittier Mills . . . Chattahoochee, Fulton Co., Ga. . Oct. 18, 1900.
George A. Wies . . . . Treas. Eureka Fire Hose Co. . . . . 13 Barclay St., New York City . . . Apr. 24, 1902.
R. W. Wight, ... Asst. Treas. Indian Orchard Co. . . . . P. O. Box 13, Indian Orchard, Mass., Apr. 28, 1904.
Edward B. Wilbur . . Vice Prest. & Supt. Mollohon Mfg. Co. Newberry, S. C. . . . Oct. 30, 1889.
Benjamin Wilcox . . . Treas. City Mfg. Co. . . . . New Bedford, Mass. . Apr. 26, 1900.
John B. Wild . . . . Prest. Oneita Knitting Mills . . . . . 842 Bleecker St., Utica, N. Y. . . . . Apr. 26, 1900.
E. Wilkinson, Jr. . . . Member Firm of E. Wilkinson & Son . . . . . Amber and Adams Sts., Philadelphia, Penn. . Sept. 13, 1906.
Eben C. Willey . . . . Supt. Barnaby Mfg. Co. . . . . 110 June St., Fall River, Mass. . . Apr. 29, 1896.
Eugene F. Willey . . . Supt. Globe Yarn Mills . . . . . Fall River, Mass. . . Sept. 13, 1906.
Franklin D. Williams . Asst. Treas. Hamilton Mfg. Co. . . 70 Kilby St. Room 48 . . . . . Boston, Mass. . . . . Apr. 25, 1901.
Henry Williams . . . Supt. Canoe River Mill, 53 Broadway, Taunton, Mass. . . . Apr. 23, 1903.
Broadus E. Willingham, Sec. and Treas. Willingham Cotton Mills . . . . . Macon, Ga. . . . . Oct. 18, 1900.
Elias S. Willis . . . . Supt. N. E. Cotton Yarn Co. . . . . Taunton, Mass. . . Apr. 23, 1903.
William E. Winchester . Director Mississippi Textile School, Agricultural College, Miss. Apr. 24, 1902.
Samuel F. Winsper . . Supt. Bennett Mill . . . . . New Bedford, Mass. . Apr. 23, 1903.

Rex G. Witherbee . . Asst. Supt. Utica Steam and Mohawk Valley Cotton Mills . . . . . Utica N. Y. . . . . Apr. 26, 1906.
Charles W. Wood . . . Mills Mgr. U. S. Cotton Duck Corporation . . . . . 809 Continental Trust Building, Baltimore, Md. . . . Sept. 21, 1905.
George Wood . . . . Prest. and Treas. Millville Manufg. Co. . . . . 626 Chestnut St., Philadelphia, Pa. . . Oct. 16, 1872.
John P. Wood . . . . . 521 N. 22d St., Philadelphia, Pa. . . Apr. 28, 1897.
Kenneth F. Wood . . Supt. Sayles Bleacheries . . . . . Sayesville, R. I. . . . Sept. 13, 1906.
Oscar W. Wood . . . Treas. Germantown Spinning Co. . . . . High St., Germantown, Philadelphia, Pa. . . Oct. 18, 1900.
William P. Wood . . . Supt. Royal Weaving Co. . . . . Pawtucket, R. I. . . Apr. 26, 1906.
Marcus J. Woodrow . . Supt. Clinton Mfg. Co., 93 Clinton St., Woonsocket, R. I. . Apr. 26, 1906.
Wm. I. Woodward . . Agt. Shetucket Co., ... Norwich, Conn. . . Apr. 23, 1903.
Frank F. Woolley . . . Supt. Coventry Co. . . . . Anthony, R. I. . . . Apr. 27, 1905.
George W. Wright . . Supt. Shove Mills . . . . . Fall River, Mass. . . Apr. 26, 1906.

Adelbert R. Young . . Supt. Ashland Cotton Co. . . . . Jewett City, Conn. . . Apr. 25, 1894.
James M. Young . . . Mgr. Hamilton Cotton Co. . . . . Hamilton, Ont., Can. Apr. 27, 1899.
Lewis J. Young . . . . Supt. Gault Mills of Montreal Cotton Co. . . . . Lock Box 240, Valleyfield, P. Q., Canada . . . . . Oct. 1, 1903.

ASSOCIATE MEMBERS.

Eugene C. Andres . . Exporter and Importer . . . . . 517 John Hancock Building, Boston, Mass. . . . . Oct. 18, 1900.
Henry B. Ashton . . . Agt. S. A. Felton & Son Co. . . . . Manet Road, Chestnut Hill, Mass. Apr. 26, 1900.
Henry Ashworth . . . Ashworth Bros. . . . . 89 Globe Mills Ave., Box 427, Fall River, Mass. . . Apr. 28, 1897.

George R. Babbitt . . . Prest. and Gen. Mgr. American Oil Co. and Prest. and Treas. . . . . The Burke Eng. Co., 182 So. Water St., Providence, R. I. . Apr. 24, 1895.
Harry Gage Baker . . Lowell Machine Shop & Kitson Machine Shop . . . . . Lowell, Mass. . . . Sept. 21, 1905.
D. C. Ball . . . . . 5 Beekman St., New York, N. Y. . . Oct. 25, 1895.
Edwin Barnes . . . . Vice Prest. American Textile Appliances Co. . . . . 79 Milk St., Boston, Mass. . . . . Apr. 26, 1900.
George S. Barnum . . Sec. and Treas. The Bigelow Co. . New Haven, Conn. . Apr. 24, 1895.
Colin C. Bell . . . . Vice-Prest. American Vulcanized Fibre Co. . . . . 12 Pearl St., Boston, Mass. . . . Apr. 29, 1896.
Frank P. Bennett . . . Publisher American Wool and Cotton Reporter . . . . . 530 Atlantic Ave., Boston, Mass. . . . Sept. 22, 1896.
William H. Bent . . . Treas. Mason Machine Works . . . Taunton, Mass. . . . April 29, 1896.
Edward H. Best . . . Woolen Merchant, 224 Purchase St., Boston, Mass. . . Apr. 23, 1903.

Albert Birch . . . . . Prop. & Mgr. Birch Bros. Co., ... 32 Kent St. Somerville, Mass. . . Oct. 2, 1902.
F. H. Bishop . . . . . Gen. Mgr. Universal Winding Co. . . . . 95 South St., Boston, Mass. . . . . Apr. 26, 1900.
Edmund E. Blake . . Agt. Saco & Pettee Machine Shops . . . Biddeford, Me. . Oct. 2, 1902.
Charles A. Bowen . . Treas. & Gen. Mgr., S. C. Lowe Supply Co. . . . . 87 Union St., New Bedford, Mass. . Apr. 26, 1906.
Arthur T. Bradlee, . . Mem. firm of Harding, Whitman & Co. . . . . 78 Chauncy St., Boston, Mass. . . . . Apr. 25, 1901.
J. Payson Bradley . . . The Kehew-Bradley Co. . . . . P. O. Box 3037, 24 Purchase St., Boston, Mass. . . . Apr. 24, 1895.
J. Frank Braids . . . . Vice Prest. Charles S. Bush Co. . . . . P. O. Box 20, 212 Weybosset St., Providence, R. I. . . Apr. 28, 1897.
Samuel N. Braman . . Engineer Westinghouse Machine Co. . . . . 131 State St., Boston, Mass. . . . Apr. 27, 1905.
James H. Brand Jr. . . Cotton Broker . . . . . 201 Board of Trade Building, Montreal, P. Q. . . . Sept. 13, 1906.
Henry Gordon Brinckerhoff, N. E. Mgr. Green Fuel Economizer Co., ... Rms. 701-703 Oliver Building, 141 Milk St., Boston, Mass. . . . Sept. 22, 1896.
Harry S. Brown . . . New England Mgr. Power Specialty Co. . . . . 10 Postoffice Square, Boston, Mass. . . . Sept. 21, 1905.
H. Martin Brown . . . Treas. U. S. Bobbin & Shuttle Co. . Providence, R. I. . . Apr. 24, 1895.
George L. Brownell . . Inventor and Builder of Improved Twisting Machinery . . . . . 49 Union St., Station A, Worcester, Mass. . . Apr. 23, 1903.
Percy H. Brundage . . . . . 49 Wall St., New York, N. Y. . . Oct. 5, 1899.
John H. Burghardt . . Page Belting Co. . . . 31 Pearl St., Boston, Mass. . . . Apr. 24, 1895.
Charles B. Burleigh . . Textile Power Dept., General Electric Co. . . . . 84 State St., Boston, Mass. . . . Oct. 1, 1903.
Eugene E. Burnham . . Belt Mfr. . . . . 252 Lowell St., Lawrence, Mass. . . Oct. 25, 1895.
Hermon N. Burpee . . Gen. Sales Mgr., Barber-Colman Co. . . . . 77 Washington St., North, Boston, Mass. . . . Sept. 13, 1906.
Arthur Cecil Butler, . . Agt. for E. A. Leigh, ... 232 Summer St. Boston, Mass. Apr. 28, 1904.
Harry W. Butterworth . Sec. H. W. Butterworth & Sons . . . . . York and Cedar Sts., Philadelphia, Pa. . . Oct. 28, 1897.
James Butterworth . Prest. H. W. Butterworth & Sons . . . . . York and Cedar Sts., Philadelphia, Pa. . . Apr. 24, 1895.

L. W. Campbell, . . . Agt. Woonsocket Machine and Press Co. . . . . Woonsocket, R. I. . . Sept. 22, 1904.
Malcolm Campbell . . Gen. Mgr. Woonsocket Machine and Press Co. . . . . Woonsocket, R. I. . . Apr. 24, 1895.
W. W. Carey . . . . . Mfr. Wood Rim Pulleys and Wood Working Machinery . . . . . 514 Broadway, Lowell, Mass. . . . . Apr. 24, 1895.
Albert C. Case . . . . . 5 Nassau St., New York, N. Y. . . Sept. 26, 1901.
Charles F. Chase . . . Eastern Mgr. Cling Surface Co., ... 39 Cortlandt St., New York, N. Y. . . Sept. 21, 1905.

J. E. Cheesman . . . . Prest. Cheesman Cotton Gin Co. . . . . .
. . . . . 76 William St., New York, N. Y. . . Oct. 5, 1899.
Charles H. Child . . . Treas. Standard Mill Supply Co. . . . . .
. . . . . P. O. Box 1426, 39 Exchange Place, Providence, R. I. . . Apr. 24, 1895.
Thomas J. Clexton . . Mgr. A. Klipstein & Co. . . . . .
. . . . . 285 Congress St. Boston, Mass. . . . Sept. 13, 1906.
Melvin H. Coffin . . . Selling Agt. Whitin Machine Works Whitinsville, Mass. . Oct. 2, 1902.
Howard D. Colman . . Prest. and Treas. Barber-Coleman Co. Rockford, Ill. . . . Apr. 27, 1905.
James A. Cooper . . . Whitin Machine Works . . . . . Whitinsville, Mass. . Sept. 13, 1906.
Charles C. Cowan . . . . . 27 William St., New York, N. Y. . . Oct. 5, 1899.
Thomas G. Cox . . . . Selling Agt. Mason Machine Works . . . . . .
. . . . . P. O. Box 316, Taunton, Mass. . . . Apr. 24, 1895.
Stewart W. Cramer . . Southern Agt., The Whitin Machine Works . . . . . .
. . . . . Woonsocket Machine & Press Co. . Charlottee, N. C. . . Apr. 26, 1906.
Randolph Crompton . . Mem. firm of Crompton-ThayerLoom Co. . . . . .
. . . . . Worcester, Mass. . . Oct. 28, 1897.
C. F. Curwen . . . . Treas. Dinsmore Mfg. Co. . . . . Salem, Mass. . . . . Apr. 27, 1899.
Joseph L. Cushing . . Prop.Daniel Cushing & Co., Box 885, Lowell, Mass. . . . Apr. 26, 1900.

Frederick I. Dana . . . Gen. Sales Mgr., The Textile Machinery Finishing Co. . .
. . . . . Providence, R. I. . . Apr. 24, 1895.
H. M. Daniel . . . . Philadelphia Mgr. The Mayo Mills and The Avalon Mills .
. . . . . 517 The Bourse, Philadelphia, Pa. . . Sept. 21, 1905.
Daniel J. Danker, . . . Mem. firm of Danker & Marston, Importers of dyestuffs and
. . . . . chemicals . . 247 Atlantic Ave., Boston, Mass. . . . Apr. 28, 1904.
Charles Henry Davis . C. E., Charles Henry Davis & Partners, ...
. . . . . 25 Broad St., New York, N. Y. . . Apr. 23, 1903.
Hugh De Haven . . Prop. De Haven Mfg. Co. . . . . .
. . . . . 50-54 Columbia Heights, Brooklyn, N. Y. . . Apr. 23, 1903.
John O. DeWolf, . . . Mech. Engineer, 159 Devonshire St., Boston, Mass. . . . Apr. 25, 1901.
Frederick N. Dillon . . D. M. Dillon Steam Boiler Works . Fitchburg, Mass. . . Sept. 22, 1904.
Ezra Dixon . . . . . Prest. and Treas. Dixon Lubricating Saddle Co. Bristol, R. I. Sept. 21, 1905.
Robert D. Douglas . . Cop Tube Manufacturer . . . . . .
. . . . . P. O. Box 704, 402 Bay St., Fall River, Mass. . . Sept. 21, 1905.
C. E. W. Dow . . . . Selling Agt. American Moistening Co. . . . . .
. . . . . P. O. Box 2189, 79 Milk St., Boston, Mass. . . . Apr. 24. 1895.
Frederick A. Downes . Prest. Keystone Mutual Fire Insurance Co. . . . . .
. . . . . 925 Chestnut St., Philadelphia, Pa. . . Oct. 28, 1897.
Clare H. Draper . . . Experimental Dept. Draper Co. . . Hopedale, Mass. . . Sept. 21, 1905.
W. L. Draper . . . . Factory Buildings Trust, 253 A St., South Boston, Mass. Oct. 18, 1900.

Charles E. Eager . . . Member firm J. Russel Marble & Co. . . . . .
. . . . . 124 High St., Boston, Mass. . . . Apr. 27, 1905.
Fred W. Easton, . . . Treas. Easton & Burnham Machine Co., ...
. . . . . 180 Weeden St., Pawtucket, R. I. . . Apr. 25, 1901.

William Dresser Edwards, Cons. Eng. Randolph Bldg. . . . . Memphis, Tenn. . . Oct. 2, 1902.
G. B. Emmons . . . . Prest. Emmons Loom Harness Co. . . . . 7 May St., Lawrence, Mass. . . Oct. 25, 1895.
George P. Erhard . . . Vice-Prest. The Geo. W. Stafford Co. Readville, Mass. . . Apr. 27, 1905.

D. D. Felton . . . . . Treas. S. A. Felton & Son Co. . . . Manchester, N. H. . Apr. 24, 1895.
John W. Ferguson . . Contractor . . . . . Paterson Nat. Bank Bldg., Paterson, N. J. . . . Apr. 24, 1895.
L. L. Flemming . . . Vice-Prest. and Gen. Mgr. American Cotton Co. . . . . 25 Broad St., Lock Box 240, New York, N. Y. . . Apr. 23, 1903.
E. C. Foerster . . . . Treas. American Textile Specialty Machinery Co. . . . . 363–373 Rider Ave., New York, N. Y. . . Sept. 22, 1904.
J. Herbert Foster . . . Cotton Broker . 10 South Water St., Providence, R. I. . . Apr. 24, 1895.
E. T. Fowler . . . . . Treas. and Mgr. Foster Machine Co., Westfield, Mass. . . Apr. 26, 1906.
John T. Fyans . . . . Agt. Fyans, Frazer & Blackway Co. . . . . 411 Beach St., Fall River, Mass. . . Apr. 28, 1897.

H. P. Garland . . . . Treas. Garland Mfg. Co. . . . . Saco, Me. . . . . Oct. 25, 1895.
Royal W. Gates . . . . Supply Dealer . . 307 Market St., Lowell, Mass. . . . Apr. 24, 1895.
Roland Gerry . . . . Asst. General Sales Agt. Jones & Laughlin Steel Co. . . . . Pittsburgh, Penn. . . Sept. 13, 1906.
Vladimir F. Gnesin . . Care, The Great Yaroslavl Mfg. Co. Moscow, Russia . . . Oct. 1, 1903.
Rufus B. Goff . . . . Prest. Standard Mill Supply Co. . . . . 77 Exchange Pl., Box 714, Providence, R. I. . . Apr. 28, 1897.
Arthur F. Gray . . . . Architect and Mill Engineer . . . . . 53 State St., Room 509, Boston, Mass. . . . Oct. 18, 1900.
Samuel M. Green, C. E. The American Thread Co. . . . . Holyoke, Mass. . . . Apr. 24, 1902.
Harry S. Greene . . . Vice Prest. Woonsocket Napping Machinery Co. . . . . Woonsocket, R. I. . . Apr. 26, 1906.
Henry S. Greene, . . . Treas. Woonsocket Napping Machinery Co. . . . . Woonsocket, R. I. . Apr. 26, 1906.
S. Harold Greene . . . Starch Manufacturer . . 367 Atlantic Ave. Boston, Mass. . Apr. 27, 1905.
Russell Grinnell . . . Vice Prest. Gen. Fire Extinguisher Co. . . . . P. O. Box 89, Providence, R. I. . . Apr. 26, 1906.

A. Walter Harris . . . Treas. A. W. Harris Oil Co. . . . . Box 758, 326 So. Water St., Providence, R. I. . . Oct. 25, 1895.
Alfred H. Hartley . . Dealer in Oils and Mill Supplies . . . . . Box 409, Fall River, Mass. . . Oct. 28, 1897.
Arthur A. Haserick . . Member of Firm Stoddard, Haserick, Richards & Co. . . . . 152 Congress St., Boston, Mass. . . . . Sept. 13, 1906.
Edgar F. Hathaway . . Gen. Mgr., American Warp Drawing Machines . . . . . 289 A St., Boston, Mass. . . . Apr. 27, 1905.
William C. Hawes . . Director Taber Mill . . Pleasant St., New Bedford . . . . Sept. 13, 1906

Charles C. Hedrick . . Mech. Eng. Lowell Machine Shop . Lowell, Mass. . . . Apr. 23, 1903.
Richard H. Hill . . . Gen. Sales Agt. James Hunter Machine Co. . . . . .
. . . . . 70 Kilby St., Boston, Mass. . . . . Apr. 26, 1900.
John Hogg . . . . . Smith, Hogg & Gardiner, 144 Essex St., Boston, Mass. . . . Apr. 27, 1899.
Henry S. Houghton, Sr., Mfr. Grids and Beaters, ...
. . . . . 74 Hamlet Ave., Woonsocket, R. I. . Apr. 28, 1897.
Lewis T. Houghton . . Mfr. Metal Thread Boards . . . . . .
. . . . . 89 Exchange St., Worcester, Mass. . . Sept. 26, 1901.
A. H. Howard . . . . Prest. and Treas. Howard Bros. Mfg. Co. . . . . .
. . . . . P. O. Box 54, Worcester, Mass. . . Sept. 26, 1901.
Frederic W. Howe . . Mgr. Providence Dept., Crompton & Knowles Loom Works
. . . . . 241 Harris Ave., Box 899, Providence, R. I. . . Apr. 24, 1902.
Samuel T. Hubbard . . Cotton Merchant, Hubbard Bros. & Co. . . . . .
. . . . . 66 Beaver St., New York City . . . Sept. 13, 1906.
C. H. Hutchins . . . . Prest. Crompton & Knowles Loom Works . . . . . .
. . . . . Worcester, Mass. . . Oct. 25, 1895.

Daniel Jackson . . . . Cotton Buyer B. B. and R. Knight, . Providence, R. I. . . Apr. 24, 1902.
David Jackson . . . . Gen. Mgr. Jackson Pat. Shell Roll Co., Pawtucket, R. I. . . Apr. 24, 1895.
Albert A. Jenks . . . . Prest. Fales & Jenks Machine Co. . Pawtucket, R. I. . . Sept. 21, 1905.

Lawrence M. Keeler . Whitin Machine Works . . . . . Whitinsville, Mass. . Sept. 26, 1901.
William B. Kehew . . The Kehew-Bradley Co., ...
. . . . . 24 Purchase St., Boston, Mass. . . . Apr. 24, 1895.
John E. Kendrick . . . Prest. American Supply Co., Box 822 . . . . . .
. . . . . 11 Eddy St., Providence, R. I. . . Oct. 5, 1899.
Frank B. Kenney . . . Mgr. Care of T. C. Entwistle Co. . . . . .
. . . . . 297 Market St., Lowell, Mass. . . . Oct. 5, 1899.
Joseph C. King . . . . Ring Traveler . . 120 Boylston St., Boston, Mass. . . . Oct. 1, 1903.

W. C. Langford . . . Salesman, ... 14 Peck St., Providence, R. I. . . Apr. 27, 1899.
Josiah M. Lasell . . . Whitin Machine Works, ... Whitinsville, Mass. . Apr. 24, 1895.
John H. Lawrence . . Top Roll Mfr. . . . . New Bedford, Mass. . Apr. 28, 1904.
Frank A. LeValley . . Cotton Broker . . . . . Fall River, Mass. . . Apr. 28, 1904.
John H. Lorimer . . . Builder of Textile Machines . . . . . .
. . . . . Ontario and Lawrence Sts., Philadelphia, Pa. . . Oct. 28, 1897.
Stephen C. Lowe . . . Agt. John Hetherington & Sons, Ltd., ...
. . . . . 186 Devonshire St., Boston, Mass. . . . Oct. 25, 1895.

Rowland N. Mackay . Agt. The George W. Stafford Co., . Readville, Mass. . . Sept. 21, 1905.
Francis E. Macomber . Mill Supplies . . . . 88 Broad St., Boston, Mass. . . . . Apr. 26, 1900.
Edwin H. Marble . . . Vice-Prest. Curtis & Marble Machine Co. . . . . .
. . . . . Cambridge St., Worcester, Mass. . . Sept. 13, 1906.

Edwin T. Marble . . . Prest. and Treas. Curtis & Marble Machine Co. . . . . Cambridge St., Worcester, Mass. . . Sept. 13, 1906.
John P. Marston . . . Mem. of firm Danker & Marston . . . . . 247 Atlantic Ave., Boston, Mass. . . . . Apr. 28, 1904.
Fay H. Martin . . . . Prest. Textile Machinery Co. . . . . 60 India St., Boston, Mass. . . . . Sept. 26, 1901.
Henry W. Mason . . . Cotton Dealer, . 10 South Water St., Providence, R. I. . . Apr. 27, 1905.
F. H. Maynard . . . . Prest. Mgr. Gen. Fire Extinguisher Co. . . . . Providence, R. I. . . Apr. 24, 1895.
John McCullough, . . . Cotton Waste Merchant . . . . . New Bedford, Mass. . April 25, 1901.
J. Franklin McFadden . Member Firm George H. McFadden & Bro. . . . . 121 Chestnut St., Philadelphia, Penn. . . Sept. 13, 1906.
H. G. McKerrow . . . Textile Machinery Importer . . . . . 31 State St., Boston, Mass. . . . Sept. 22, 1896.
D. K. McLaren . . . . Mfr. of Leather Belting 751 Craig St., Montreal, P. Q., Can. Apr. 26, 1900.
Meldon H. Merrill . . Eng. Westinghouse Elec. & Mfg. Co., ... 716 Board of Trade Bldg. Boston, Mass. . . . . Sept. 22, 1904.
Charles B. Moore . . . Mgr. Knowles Steam Pump Works . . . . . 42 Batterymarch St., Boston, Mass. . . . . Apr. 26, 1900.
Fred Moss . . . . . Holland & Webb, Commission Merchants . . . . . 495 Broome St., New York, N. Y. . . Sept. 21, 1905.

Hugh Nelson . . . . Mgr. Casualty Co. of America . . . . . 52 William St., New York City . . Apr. 26, 1906.
John H. Nelson . . . . Treas. William Firth Co. . . . . 60 Baltimore St., Lynn, Mass. . . . . Apr. 26, 1900.
Charles H. Newman . . Webster Mfg. Co. 88 & 90 Reade St., New York, N. Y. . . Sept. 21, 1905.
William R. Noone Jos. Noone's Sons Co. . . 102 South St., Boston, Mass. . . . Oct. 28, 1897.

Thos. J. O'Keefe . . . Mgr. Charles L. Ireson . . . . . 148 High St., Boston, Mass. . . . . Apr. 28, 1904.

Sidney B. Paine . . . General Electric Co. . . 84 State St., Boston, Mass. . . . Apr. 24, 1895.
William F. Parish, Jr. . Chief Engineer, Deutsche Vacuum Oil Co. . . . . Berlin, N. W. 7 Reichstagsufer 16, Germany, Apr. 24, 1902.
Arthur Parkinson . . . Selling Agt. Arabol Mfg. Co. . . . . 100 William St., New York, N. Y. . . Apr. 28, 1897.
John Parmenides . . . Choremi, Benachi & Co., 50 State St., Boston, Mass. . . . . Apr. 27, 1905.
Stephen Minot Pitman . Sec'y Narragansett Mutual Fire Insurance Co. . . . . 721 Banigan Bldg., Box 315, Providence, R. I. . . Apr. 24, 1895.
James C. Potter . . . . Prest. of Potter & Johnson Co. . . . Pawtucket, R. I. . . Sept. 21, 1905.
Charles A. M. Praray . Chas. A. M. Praray & Co., Architect and Mill Engineer . . . . . 48 Weybosset St., Providence, R. I. . . Apr. 28, 1897.

Charles F. Pray . . . . Cloth Broker . . . 66 Leonard St., New York, N. Y. . . Apr. 28, 1904.
James M. Pendergast . J. M. Pendergast & Co., Brokers in Cotton Cloths and Yarns
. . . . . 87 Milk St., Boston, Mass. . . . Apr. 26, 1906.
Theodore H. Price . . Cotton Dealer . . . 82 Beaver St., New York, N. Y. . . Oct. 2, 1902.

Frank W. Reynolds . . Mem. firm Lockwood Greene & Co. . . . . .
. . . . . 93 Federal St., Boston, Mass. . . . Apr. 28, 1904.
Peleg A. Rhodes . . . Sec. Cotton Mill Mutual Fire Insurance Co. . . . . .
. . . . . Augusta, Ga. . . . . Oct. 5, 1899.
Richard H. Rice . . . Engineer Turbine Dept. Gen. Elec. Co. West Lynn, Mass. . . Apr. 24, 1895.
E. R. Richardson . . . Asst. Treas. Howard & Bullough American Machine Co., Ltd.
. . . . . Box 678, Pawtucket, R. I. . . Apr. 26, 1900.
C. E. Roberts . . . . Mgr. Hartford Steam Boiler Inspection & Insurance Co. .
. . . . . 101 Milk St., Room 400, Boston, Mass. . . . Apr. 24, 1895.
Elwin H. Rooney . . . The Whitin Machine Works . . . Whitinsville, Mass. . Apr. 26, 1906.
E .A. Rusden . . . . Gen. Mgr. Textile Finishing Machinery Co. . . . . .
. . . . . 17 Exchange Place, Providence, R. I. . . Sept. 21, 1905.

J. L. Sanford . . . . . Acting Mgr. Barber-Colman Co. . . . . .
. . . . . 77-79 Washington St., North, Boston, Mass. . . . Apr. 27, 1905.
William B. Scofield . . Sec'y Crompton-Thayer Loom Co. . Worcester, Mass. . . Apr. 28, 1904.
Dwight Seabury . . . Mill Engineer . . . 12 East Ave., Pawtucket, R. I. . . Apr. 25, 1901.
Frederick P. Shaw . . Prest. and Gen. Mgr. Shaw Machine Co. . . . . .
. . . . . Lowell, Mass. . . . Apr. 26, 1906.
William N. Shaw . . . Treas. The Lincoln Iron Works and Jackson Architectural
. . . . . Iron Works . . 31 E. 17th St., New York, N. Y. . . Apr. 24, 1902.
Arthur N. Sheldon . . F. P. Sheldon & Co. Mill Engineers . . . . . .
. . . . . 49 Westminster St., Providence, R. I. . . Sept. 13, 1906.
Lewis T. Shurtleff . . . Agt. Paper Department, Pairpont Corporation, ...
. . . . . New Bedford, Mass. Apr. 28, 1904.
Abbott P. Smith . . . Director Soule, Butler and Kilburn Mills . . . . . .
. . . . . Seventh St., New Bedford, Mass. . . Sept. 13, 1906.
Harry M. Smith . . . . . Worcester, Mass. . . Apr. 28, 1897.
R. Paul Snelling . . . Treas. Saco and Pettee Machine Shops . . . . . .
. . . . . Newton Upper Falls, Mass. . Sept. 22, 1896.
W. A. Spellissy . . . . of Dolier & Co., Yarn Commission Merchants . . . . .
. . . . . Mariner and Merchants Building, Philadelphia, Pa. . . Sept. 21, 1905.
Henry C. Spence . . . Gen. Mgr. Metallic Drawing Roll Co. Indian Orchard, Mass. Apr. 24. 1895.
Wallace I. Stimpson . Salesman The Draper Co. . . . . Hopedale, Mass. . . Sept. 21, 1905.
James Strang . . . . Selling Agt. Metallic Drawing Roll Co. . . . . .
. . . . . 123 Hampden St., Indian Orchard, Mass. Oct. 28, 1897.
Jacob Stephans . . . . Gen. Mgr. William H. Haskell Mfg. Co. . . . . .
. . . . . Pawtucket, R. I. . . Apr. 26, 1906.
Daniel J. Sully . . . . Cotton Broker, T. M. Reynolds & Co., ...
. . . . . 34 South Water St., Providence, R. I. . . Apr. 24, 1895.

E. Kent Swift . . . . Whitin Machine Works, ... Whitinsville Mass. . . Apr. 27, 1905.
John Sykes, J. P. . . . Prest. English Card Clothing Co. . . . . .
. . . . . Acre House, Huddersfield, Eng. . Oct. 18, 1900.

Charles F. Taylor . . . Prop. Burgess Cop Tube Co., ...
. . . . . 15 Custom House St., Providence, R. I. . . Apr. 27, 1898.
Elwood E. Taylor . . . N. E. Mgr., Stoker Dept. Amer. Ship Windlass Co. of Provi-
. . . . . dence, R. I., 12 Humbolt Ave., Boston, Mass. . . . Apr. 23, 1903.
Robert Taylor, Jr. . . Managing Director Soho Iron Wks., Oldham, England . . Apr. 28, 1904.
George C. Tewksbury . Agt. American Ship Windlass Co. . . . . .
. . . . . 141 Milk St., Room 1102 Boston, Mass. . . . Apr. 24, 1902.
James T. Thornton . . Treas. Thornton Machinery Co. . . Providence, R. I. . . Oct. 18, 1900.
William V. Threlfall . . Chapman Valve Mfg. Co. . . . . Indian Orchard, Mass., Apr. 24, 1895.
Rienzi W. Thurston . Mach. Mfr. . . . . Fall River, Mass. . . Oct. 18, 1900.
H. A. Tillinghast, . . . Sec'y & Treas. The Textile Finishing Mach. Co. . . . . .
. . . . . Providence, R. I. . . Apr. 25, 1901.
A. Curtis Tingley . . . Treas. National Ring Traveler Co. . . . . .
. . . . . 257 West Exchange St., Providence, R. I. . . Sept. 22, 1896.
Allison W. Trafford . . Mfr. of Ring Travelers . . . . . .
. . . . . 221–223 Pocasset St., Fall River, Mass. . . Apr. 26, 1900..

Frank H. Underwood . Resident Mgr. Dodge Mfg. Co. . . . . .
. . . . . 137 Purchase St., Boston, Mass. . . . Apr. 29, 1896.

Clement A. Wakefield . Selling Agt. Saco & Pettee Machine Shops, ...
. . . . . 38 South St., Biddeford, Me. . . . Apr. 25, 1901.
Justin A. Ware . . . . . Spring Hill, Barnstable County, Mass. Oct. 25, 1895.
William Warr . . . . Pacific Electrical Building . . . . . Los Angeles, Cal. . . Apr. 27, 1905.
Lettice R. Washburn . Mill Contractor, 235 North Water St., New Bedford, Mass. . Oct. 5, 1899.
Walter S. Watson . . . Haworth & Watson, Mfrs. Paper Tubes for Textile Manufg.
. . . . . Box 996, Lowell, Mass. . . . . Oct. 25, 1895.
Sephen M. Weld, . . Stephen M. Weld & Co., 89 State St., Boston, Mass. . . . Apr. 27, 1899.
William R. West . . . Roll Coverer . . 830 Purchase St., New Bedford, Mass. . Sept. 22, 1896.
W. W. White . . . . Prest. Holyoke Machine Co. . . . Worcester, Mass. . . Apr. 27, 1899.
John K. Whittier . . . Supt. Kitson Machine Shop . . . . Lowell, Mass. . . . Sept. 21, 1905.
G. Marston Whitin . . Treas. Whitin Machine Works . . . Whitinsville, Mass. . Apr. 24, 1895
Fred A. Wilde . . . . Agt. George W. Stafford Co. . . . Readville, Mass. . . Apr. 28, 1897.
Erving Yale Woolley . Sel. Agt. Stoddard, Haserick, Richards & Co. . . . . .
. . . . . 152 Congress St., Boston, Mass. . . . . Apr. 24, 1895.

Honorary Members	5
Life Members	12
Active Members	687
Associate Members	192
Total Membership	896

MEMBERS OF THE ASSOCIATION,

October 1, 1906.

ARRANGED BY STATES.

MAINE.

Auburn	William Hayes	Barker Mill.
Augusta	Albert S. Pratt	Edwards Mfg. Co.
Bath	Harry W. Kimball	
Biddeford	Edmund E. Blake	Saco & Pettee Machine Shops.
Biddeford	Harry D. Lord	Saco & Pettee Machine Shops.
Biddeford	Robert McArthur	Pepperell Mfg. Co.
Biddeford	Clement A. Wakefield	Saco & Pettee Machine Shops.
Brunswick	Russell W. Eaton	Cabot Manufg. Co.
Kennebunk	Robert W. Lord	R. W. Lord & Co.
Lewiston	George W. Bean	Androscoggin Mills.
Lewiston	H. B. Estes	Continental Mills.
Lewiston	William D. Pennell	Hill Manufg. Co.
Lewiston	Herbert L. Pratt	Bates Manufg. Co.
Portland	Lyman M. Cousens	Dana Warp Mills.
Saco	H. P. Garland	Garland Mfg. Co.
Saco	James G. Garland	Garland Mfg. Co.
Saco	Elmer E. Page	York Manufg. Co.
Westbrook	Philip Dana	Dana Warp Mills.
Westbrook	Woodbury K. Dana	Dana Warp Mills.

NEW HAMPSHIRE.

Charlestown	Samuel Webber	Hydraulic Engineer.
Claremont	Frank P. Vogl	Monadnock Mills.
Claremont	Walter Whipple	Monadnock Mills.
Dover	Charles H. Fish	Cocheco Manufg. Co.
Dover	Herbert W. Owen	Cocheco Manufg. Co.
Exeter	Chester D. Hatch	Exeter Mfg. Co.
Greenville	Frederick W. Ely	Columbian Manufg. Co.

Hooksett	Stephen N. Bourne	Dundee Mills.
Manchester	Henry Deane Bourne	Hooksett Manufg. Co.
Manchester	D. D. Felton	S. A. Felton & Son Co.
Manchester	Elliott Cowdin Lambert	Amoskeag Manufg. Co.
Manchester	Charles H. Manning	Amoskeag Manufg. Co.
Manchester	Herman F. Straw	Amoskeag Manufg. Co. & Manchester Mills.
Manchester	George F. Whitten	
Manchester	John H. Whitten	Stark Mills.
Milford	M. F. Foster	
Nashua	William F. Arthur	Nashua Manufacturing Co.
Nashua	William H. Cadwell	Jackson Co.
Nashua	Almon A. Milliken	The Jackson Co.
Nashua	Roscoe S. Milliken	Nashua Mfg. Co.
Newmarket	William H. Garner	Newmarket Mfg. Co.
Penacook	Marcellus Gould	N. H. Spinning Mills.
Penacook	F. E. Wattles	Boscawen Mills.
Peterboro	Albert W. Noone	Jos. Noone's Son's Co.
Pittsfield	William P. Adams	Pittsfield Mills.
Salmon Falls	J. Colby Lewis	Salmon Falls Mfg. Co.
Somersworth	Charles H. Plummer	Great Falls Manufg. Co.
Suncook	William G. Nichols	China, Webster & Pembroke Mills.
Suncook	Edmund E. Truesdell	China, Webster & Pembroke Mills.

VERMONT.

Burlington	Reuben A. Cooke	Queen City Cotton Co.
Burlington	Winthrop Parker	Queen City Cotton Co.
North Pownal	Thomas Armstrong	North Pownal Manufg. Co.

MASSACHUSETTS.

Adams	Joseph Brierley	W. C. Plunkett & Sons Warp Mill.
Adams	Z. D. Hall	Berkshire Cotton Manufg. Co.
Adams	Emil Kipper	Blackington Mfg. Co.
Adams	Charles T. Plunkett	Berkshire Cotton Manufg. Co.
Adams	William B. Plunkett	Berkshire Cotton Mfg. Co., and Greylock Mills.
Adams	William C. Plunkett	W. C. Plunkett & Sons.
Adams	J. N. Sanderson	Renfrew Mfg. Co.
Adams	Charles R. Thomson	Renfrew Mfg. Co.
Adamsdale	Fred B. Manley	Spencer Yarn Co.
Amesbury	Frederick J. Quinn	Hamilton Woolen Mills.
Andover	John W. Bell	Smith & Dove Manufg. Co.
Blackstone	George E. Spofford	Blackstone Manufg. Co.
Bondsville	Elmer G. Childs	Boston Duck Co.

Bondsville	Samuel Stewart	Boston Duck Co.
Boston	Charles B. Amory	Hamilton Mfg. Co.
Boston	Frederic Amory	189 Devonshire St.
Boston	Eugene C. Andres	517 John Hancock Building.
Boston	E. W. Atkinson	Stoddard, Haserick, Richards & Co.
Boston	Nathaniel F. Ayer	10 P. O. Square.
Boston	Edwin Barnes	American Textile Appliances Co.
Boston	Colin C. Bell	American Vulcanized Fibre Co.
Boston	Albert Farwell Bemis	Jackson Fibre Co.
Boston	Frank P. Bennett	Am. Wool and Cotton Reporter.
Boston	Edward H. Best	Woolen Merchant.
Boston	F. H. Bishop	Universal Winding Co.
Boston	Arthur T. Bradlee	Harding, Whitman & Co.
Boston	J. Payson Bradley	The Kehew-Bradley Co.
Boston	Samuel N. Braman	Westinghouse Machine Co.
Boston	S. Parker Bremer	Monadnock Mills.
Boston	Henry Gordon Brinckerhoff	Green Fuel Economizer Co.
Boston	Harry S. Brown	New England Power Specialty Co.
Boston	John H. Burghardt	Page Belting Co.
Boston	Charles B. Burleigh	General Electric Co.
Boston	Hermon N. Burpee	Barber-Colman Co.
Boston	Arthur Cecil Butler	232 Summer St.
Boston	Thomas J. Clexton	A. Klipstein & Co.
Boston	Frank B. Comins	American Moistening Co.
Boston	Alphonse S. Covel	Tremont and Suffolk Mills.
Boston	Daniel J. Danker	Danker & Marston.
Boston	Augustus De Cort	724 Exchange Building.
Boston	P. Y. DeNormandie	Pepperell Mfg. Co.
Boston	John O. DeWolf	159 Devonshire St.
Boston	C. E. W. Dow	150 Devonshire St.
Boston	Frederic C. Dumaine	Amoskeag Mfg. Co.
Boston	Charles E. Eager	J. Russel Marble & Co.
Boston	William Firth	Am. Moist. Co. and Wm. Firth Co.
Boston	Frederick O. Flather	Boott Mills.
Boston	Alfred M. Goodale	Cloth and Yarn Broker.
Boston	Arthur F. Gray	53 State St., Room 509.
Boston	Edwin Farnham Greene	Lockwood, Greene & Co. and Dwight Mfg. Co.
Boston	S. Harold Greene	Starch Mfg.
Boston	Arther A. Haserick	Stoddard, Haserick, Richards & Co.
Boston	Edgar F. Hathaway	American Warp Drawing Machine Co
Boston	Richard H. Hill	Jas. Hunter Machine Co.
Boston	William H. Hill	Renfrew Mfg. Co.
Boston	Franklin W. Hobbs	Arlington Mills.
Boston	John Hogg	Smith, Hogg & Gardiner.
Boston	Henry S. Howe	Dry Goods Commission.
Boston	Charles W. Hubbard	Ludlow Mfg. Associates.

Boston	Otis L. Humphrey	78 Chauncy St.
Boston	Joseph B. Jamieson	Holmes Knitting Co.
Boston	William B. Kehew	The Kehew-Bradley Co.
Boston	Joseph C. King	120 Boylston St.
Boston	Evan Arthur Leigh	232 Summer St.
Boston	William C. Lovering	Whittenton Mfg. Co.
Boston	Stephen C. Lowe	John Hetherington & Sons, Ltd.
Boston	Herbert Lyman	39 Beacon St.
Boston	Ronald T. Lyman	Boston Mfg. Co.
Boston	Francis E. Macomber	88 Broad St.
Boston	Charles T. Main	Dean & Main.
Boston	John P. Marston	Danker & Marston.
Boston	Fay H. Martin	Textile Machinery Co.
Boston	Fred C. McDuffie	24 Milk St.
Boston	H. G. McKerrow	31 State St.
Boston	Meldon H. Merrill	Westinghouse Elec. & Mfg. Co.
Boston	Charles B. Moore	Knowles Steam Pump Works.
Boston	George B. Morison	Ballou Yarn Co.
Boston	Robert W. Neff	Chemical Mfr.
Boston	William R. Noone	102 South St.
Boston	Thomas J. O'Keefe	148 High St.
Boston	John Parmenides	Choremi, Benachi & Co.
Boston	Sidney B. Paine	General Electric Co.
Boston	James M. Prendergast	J. M. Prendergast & Co.
Boston	Henry Smith Pritchett, LL.D.	Mass. Institute of Technology.
Boston	Frank W. Reynolds	Lockwood Greene & Co.
Boston	Charles E. Riley	C. E. Riley & Co.
Boston	C. E. Roberts	Hartford Steam Boiler Insp. & Ins.Co
Boston	Arnold B. Sanford	Kennebec Spinning Mills.
Boston	J. L. Sanford	Barber-Colman Co.
Boston	J. Herbert Sawyer	93 Federal St.
Boston	George H. Shapley	Silver Lake Co.
Boston	Willis S. Shepard	American Net and Twine Co.
Boston	William F. Sherman	294 Washington St.
Boston	John Sullivan	C. E. Riley & Co.
Boston	Elwood E. Taylor	Amer. Ship Windlass Co.
Boston	George C. Tewksbury	Amer. Ship Windlass Co.
Boston	James P. Tolman	Samson Cordage Works.
Boston	Edward B. Townsend	Warwick Mills.
Boston	Frank H. Underwood	Dodge Mfg. Co.
Boston	Stephen M. Weld	89 State St.
Boston	W. B. Smith Whaley	1012 Tremont Bldg.
Boston	William Whitman	Arlington Mills.
Boston	Franklin D. Williams	Hamilton Mfg. Co.
Boston	Erving Yale Woolley	Stoddard Haserick, Richards & Co
Chelsea	Augustus T. Clark	American Circular Loom Co.
Chelsea	Eugene Finocchiaro	532 Broadway.

Chestnut Hill	Henry B. Ashton	Manet Road.
Chicopee	O. D. Drew	Dwight Mfg. Co.
Chicopee Falls	M. A. Rawlinson	Chicopee Mfg. Co.
Clinton	William G. McLoon	Lancaster Mills.
Clinton	Charles H. Richardson	Lancaster Mills.
East Cambridge	Ivers S. Adams	American Net and Twine Co.
East Dedham	Benjamin M. Earl	Merchant Dye Works.
Easthampton	George A. Ayer	West Boylston Co.
Easthampton	Charles E. Childs	West Boylston Co. & Hampton Co.
Easthampton	John Skinner	West Boylston Mfg. Co.
Fall River	F. S. Akin	Cornell Mills.
Fall River	Henry Ashworth	Ashworth Bros.
Fall River	J. W. Bailey	The Bradford Durfee Textile School.
Fall River	William M. Batt	The Davol Mills.
Fall River	John P. Bodge	Arkwright Mills.
Fall River	Jefferson Borden, Jr.	Fall River Bleachery Co.
Fall River	Nathaniel B. Borden	Barnard Manufg. Co.
Fall River	Richard B. Borden	Richard Borden Mfg. Co.
Fall River	James T. Broadbent	Bradford Durfee Textile School.
Fall River	Isaac A. Brown	Narragansett Mills.
Fall River	Simeon B. Chase	King Philip Mills.
Fall River	John A. Collins	American Linen Co.
Fall River	Thomas D. Covel	The Covel and Osborne Co.
Fall River	Frederick E. Cunneen	Seaconnet Mills.
Fall River	Bradford D. Davol	Barnard Manufg. Co.
Fall River	George Delano	Bourne Mills.
Fall River	Robert D. Douglas	402 Bay St.
Fall River	Frank H. Dwelly	Tecumseh Mills.
Fall River	David H. Dyer	D. H. Dyer & Son.
Fall River	John H. Estes	Cotton Manufacturer.
Fall River	William Evans	Hargraves and Parker Mills.
Fall River	Charles F. Farrar	83 Warren St.
Fall River	John T. Fyans	Fyans, Frazer & Blackway Co.
Fall River	Arthur M. Hamilton	
Fall River	John F. Hamlet	P. O. Box 160
Fall River	Alfred H. Hartley	Oils and Mill Supplies.
Fall River	William Hathaway	Barnard Mfg. Co.
Fall River	William B. Hawes	Yarn Broker.
Fall River	George H. Hills	Davol Mills and Stevens Mfg. Co
Fall River	John H. Holt	Luther Mfg Co.
Fall River	William P. Holt	158 Jackson St.
Fall River	John Kniveton	Bradford Durfee Textile School.
Fall River	Frank A. Le Valley	Cotton Broker.
Fall River	Leontine Lincoln	Seaconnet Mills.
Fall River	Charles B. Luther	Luther Mfg. Co.
Fall River	Alexander Makepeace	Richard Borden Mfg. Co.

Fall River	Arthur H. Mason	Davis Mills.
Fall River	Philip A. Mathewson	King Philip Mills.
Fall River	Thomas McAuliffe	Stevens Manufg. Co.
Fall River	James A. McLane	Davis Mills.
Fall River	William A. Nichols	120 Pine St., Fall River.
Fall River	Robert Place	Supt. Flint Mills.
Fall River	Joseph H. Potter, Jr.	Durfee Mills.
Fall River	John Bion Richards	Davis Mills.
Fall River	Harry J. Ricketson	Merchants' Mfg. Co.
Fall River	Benj. H. Roberts	163 Grove St.
Fall River	Charles M. Shove	Granite Mills.
Fall River	W. Frank Shove	Pocassett Mfg. Co.
Fall River	Abbott E. Slade	Laurel Lake Mills.
Fall River	J. C. Smith	Chace Mills.
Fall River	Timothy Sullivan	Stafford Mills.
Fall River	James O. Thompson, Jr.	Wampanoag Mills.
Fall River	Rienzi W. Thurston	Machine Mfr.
Fall River	M. J. Toohey	Mfr. Rope, Twine and Banding.
Fall River	Allison W. Trafford	Mfr. Ring Travelers.
Fall River	Robinson Walmsley	Tecumseh Mills.
Fall River	Frederick E. Waterman	Stafford and Cornell Mills.
Fall River	Joseph Watters	Osborn Mills.
Fall River	Eben C. Willey	Barnaby Mfg. Co.
Fall River	Eugene F. Willey	Globe Yarn Mills.
Fall River	George W. Wright	Shove Mills.
Fisherville	Albert W. Dimick	Fisher Mfg. Co.
Fisherville	Charles W. Fisher	Fisher Mfg. Co.
Fiskdale	John Gregson	Fiskdale Mills.
Fitchburg	Frederick N. Dillon	D. M. Dillon Steam Boiler Works.
Fitchburg	James C. Eteson	Orswell Mills.
Fitchburg	Ernest L. Hersom	Nockedge Mills.
Fitchburg	George P. Grant, Jr.	Grant Yarn Co.
Fitchburg	W. E. Keach	Grant Yarn Co.
Fitchburg	Arthur H. Lowe	Parkhill Manufg Co.
Fitchburg	David Lowe	Parkhill Manufg. Co.
Fitchburg	William F. Morgan	Fitchburg Duck Mills.
Fitchburg	Thomas C. Sheldon	8 School St.
Fitchburg	Walter F. Stiles	Orswell Mills.
Fitchburg	Ralph E. Thomson	Parkhill Manufg. Co., Mill C.
Great Barrington	Jno. H. C. Church	Monument Mills.
Griswoldville	Joseph W. Ballard	Griswoldville Mfg. Co
Holyoke	Samuel M. Green	The American Thread Co.
Holyoke	Ernest Lovering	Lyman Mills.
Holyoke	Willard W. Stearns	Farr Alpaca Co.
Hopedale	Clare H. Draper	Experimental Dept. Draper Co.
Hopedale	Eben S. Draper	Draper Co.
Hopedale	George A. Draper	Draper Co.

Hopedale	George Otis Draper	Draper Co.
Hopedale	William F. Draper	Draper Co.
Hopedale	Frank J. Dutcher	Draper Co.
Hopedale	Wallace I. Stimpson	The Draper Co.
Housatonic	Theodore Ellis Ramsdell	Monument Mills.
Hyde Park	Calvin H. Lee	Readville Cotton Mills.
Indian Orchard	William C. Godfrey	Indian Orchard Co.
Indian Orchard	Henry C. Spence	Metallic Drawing Roll Co.
Indian Orchard	James Strang	Metallic Drawing Roll Co.
Indian Orchard	William V. Threlfall	Chapman Valve Mfg. Co.
Indian Orchard	R. W. Wight	Indian Orchard Co.
Lancaster	Henry D. Martin	Lancaster Mlils.
Lawrence	James W. Ahmuty	Atlantic Cotton Mills.
Lawrence	Joshua D. Armitage	247 Haverhill St.
Lawrence	William A. Barrell	Lawrence Duck Co.
Lawrence	Joseph P. Battles	The Textile Mach'y Specialty Co.
Lawrence	Albert W. Brainard	Box 33.
Lawrence	Eugene E. Burnham	252 Lowell St.
Lawrence	G. B. Emmons	Emmons Loom Harness Co.
Lawrence	William D. Hartshorne	Arlington Mills.
Lawrence	Walter M. Hastings	Arlington Mills.
Lawrence	John T. Lord	Pacific Mills.
Lawrence	Alvin S. Lyon	Wood Worsted Mill.
Lawrence	James I. Milliken	Everett Mills.
Lawrence	Walter E. Parker	Pacific Mills.
Lawrence	Robert Redford	Box 28.
Lawrence	Francis H. Silsbee	Pacific Mills.
Lawrence	Walter H. Summersby	Atlantic Cotton Mills.
Lawrence	William D. Twiss	Everett Mills.
Lawrence	William S. Whitney	American Woolen Co.
Leicester	Charles A. Denny	
Linwood	Amos G. Maddox	Linwood Cotton Mill.
Lowell	George E. Ames	Lawrence Manufg. Co.
Lowell	Harry Gage Baker	Lowell Machine Shop and Kitson Machine Shop.
Lowell	Charles Ray Blake	Tremont and Suffolk Mills.
Lowell	Norman E. Borden	Lowell Weaving Co.
Lowell	Frank A. Bowen	Appleton Co.
Lowell	Edward N. Burke	Lowell Machine Shop.
Lowell	W. W. Carey	Wood Rim Pulleys and Wood Working Machinery.
Lowell	Alfred M. Chadwick	Tremont and Suffolk Mills.
Lowell	Clarence N. Childs	Hamilton Mfg. Co.
Lowell	Avery B. Clark	Merrimack Mfg. Co.
Lowell	John J. Connell	Tremont and Suffolk Mills.
Lowell	A. G. Cumnock	Appleton Co.
Lowell	Joseph L. Cushing	Daniel Cushing & Co.

Lowell	Albert Deabill	Lowell Hosiery Co.
Lowell	Edward P. Dennis	50 Chelmsford St.
Lowell	John H. Dunn	Tremont & Suffolk Mills.
Lowell	William Ambrose Eastman	Hooper Knitting Co.
Lowell	George Fish	Massachusetts Cotton Mills.
Lowell	John W. Foster	Hamilton Mfg. Co.
Lowell	Royal W. Gates	Josiah Gates & Sons.
Lowell	Percy Gulline	Merrimack Print Works.
Lowell	Walter B. Hall	Hamilton Mfg. Co.
Lowell	William E. Hall	Shaw Stocking Co.
Lowell	Charles C. Hedrick	Lowell Machine Shop.
Lowell	P. T. Jackson, Jr.	Lowell Weaving Co.
Lowell	Nelson D. Keables	Mass. Cotton Mills.
Lowell	Frank B. Kenney	T. C. Entwistle Co.
Lowell	Fred Lacey	Boott Mills.
Lowell	Charles F. Libby	Shaw Stocking Co.
Lowell	Albert H. Morton	Lowell Machine Shop.
Lowell	Will Nelson	Lowell Textile School.
Lowell	Franklin Nourse	Lawrence Manufg. Co.
Lowell	Louis Atwell Olney	Lowell Textile School.
Lowell	John W. Pead	1072 Bridge St.
Lowell	Haven C. Perham	Kitson Machine Co.
Lowell	John J. Rooney	Tremont & Suffolk Mills.
Lowell	Frederick P. Shaw	Shaw Machine Co.
Lowell	Stephen E. Smith	Lowell Textile School.
Lowell	William S. Southworth	Mass. Cotton Mills.
Lowell	Berton A. Thissell	Boott Cotton Mills.
Lowell	Earl A. Thissell	Lowell Hosiery Co.
Lowell	Ariel C. Thomas	Boott Cotton Mills.
Lowell	Charles T. Upton	63 Mt. Vernon St.
Lowell	Fenwick Umpleby	Lowell Textile School.
Lowell	Jude C. Wadleigh	Merrimack Mfg. Co.
Lowell	Frederick T. Walsh	Thomas Leyland & Co.
Lowell	Walter S. Watson	Haworth & Watson.
Lowell	Channing Whitaker	Lowell Machine Shop.
Lowell	John K. Whittier	Kitson Machine Shop.
Lynn	John H. Nelson	Wm. Firth Co.
Lynn	Richard H. Rice	Gen. Elec. Co.
Lynn	Henry B. Sprague	Boston Woven Hose and Rubber Co.
Lynn	C. J. H. Woodbury	51 Baltimore St.
Malden	Lewis Dexter Jr.	65 LaCasas St.
Manchaug	T. B. Stevenson	Manchaug Co.
Melrose	George E. Prest	9 Russell St.
Melrose	John E. Prest	9 Russell St.
Methuen	Lewis E. Barnes	Pemberton Co. and Methuen Co.
Methuen	John H. Binns	Arlington Mills.
Methuen	Alfred Sagar	Arlington Cotton Mills.

Millbury	Fred W. Moore	Cordis Mills.
Millbury	Francis H. Rice	Holbrook Mfg. Co.
Nahant	Henry S. Houghton, Jr.	
New Bedford	Charles A. Bowen	S. C. Lowe Supply Co.
New Bedford	Christopher P. Brooks	International Correspondence Schoo
New Bedford	William A. Congdon	Whitman Mills.
New Bedford	Richard Cowell	290 Summer St.
New Bedford	William W. Crapo	Wamsutta Mills.
New Bedford	Mark B. Creed	Wamsutta Mills.
New Bedford	Charles Owen Dexter	Beacon Mfg. Co.
New Bedford	John A. Fernley	Butler Mill.
New Bedford	Arnold C. Gardner	Manomet Mills.
New Bedford	William Edwin Hatch	New Bedford Textile School.
New Bedford	William C. Hawes	Taber Mill.
New Bedford	Hiram Higham	Wamsutta Mills.
New Bedford	Clark W. Holcomb	Old Colony Mills, Taunton.
New Bedford	Charles M. Holmes	Box 96.
New Bedford	Leonard Johnson	Page Mfg. Co.
New Bedford	Nathaniel B. Kerr	Butler Mill.
New Bedford	John W. Knowles	Page Mfg. Co.
New Bedford	Walter H. Langshaw	Dartmouth Manufg. Corp.
New Bedford	John H. Lawrence	Top Roll Mfg.
New Bedford	Frederick B. Macy	Soule Mills.
New Bedford	John McCullough	Cotton Waste Merchant.
New Bedford	Robert P. McEwen	Lambeth Rope Corp.
New Bedford	John Neild	Grinnell Mfg. Corp.
New Bedford	H. W. Nichols	New Bedford Textile School.
New Bedford	Walter H Paige	Wamsutta Mills.
New Bedford	Albert R. Pierce	Pierce Mfg. Corp.
New Bedford	Andrew G. Pierce, Jr.	Pierce Mfg. Corp.
New Bedford	Frederick W. Reynolds	Potomska Mills.
New Bedford	Lewis T. Shurtleff	Pairpoint Corp.
New Bedford	Abbott P. Smith	Soule, Butler and Kilburn Mills.
New Bedford	Rufus A Soule	Soule Mills.
New Bedford	Rufus A. Soule, Jr.	Taber Mill.
New Bedford	William C. Taber	Whitman Mills and Beacon Mfg. Co.
New Bedford	Frederic Taber	Taber Mill.
New Bedford	Samuel Taylor	Soule Mill.
New Bedford	Herbert E. Walmsley	Wamsutta Mills.
New Bedford	Lettice R. Washburn	235 North Water St.
New Bedford	William R. West	830 Purchase St.
New Bedford	Benjamin Wilcox	Bennett Mill.
New Bedford	Eugene F. Willey	Bennett and Columbia Mills.
New Bedford	Samuel F. Winsper	Bennett Mill.
Newton	Josiah G. Coburn	99 Washington St.
Newtonville	Oscar B. Truesdell	18 Washington Terrace.
Newton Upper Falls	Frank J. Hale	Saco and Pettee Machine Shops.

Newton Upper Falls	R. Paul Snelling	Saco and Pettee Machine Shops.
North Adams	William K. Greer	Eclipse & Beaver Mills.
North Adams	Hervey Burnham	Beaver Mills and Eclipse Mill.
Northbridge	Earl S. Jenckes	Paul Whitin Mfg. Co.
Northbridge	Henry T. Whitin	Paul Whitin Manufg. Co.
Northbridge	Paul Whitin	Paul Whitin Mfg. Co.
North Brookfield	W. Marshall Taylor	Indian Orchard Flax Co.
North Oxford	Edwin N. Bartlett	Edwin Bartlett Co.
North Plymouth	Gideon F. Holmes	Plymouth Cordage Co.
North Uxbridge	Fred B. Whitin	Uxbridge Cotton Mills.
Readville	George P. Erhard	The Geo. W. Stafford Co.
Readville	Rowland N. Mackay	The George W. Stafford Co.
Readville	Fred A. Wilde	Geo. W. Stafford Co.
Salem	Orin F. Bennett	Naumkeag Steam Cotton Co.
Salem	C. F. Curwen	Dinsmore Mfg. Co.
Salem	William P. McMullan	Naumkeag Steam Cotton Co.
Salem	Henry Osgood	P. O. Box 204.
Salem	Nathaniel G. Simonds	Naumkeag Steam Cotton Co.
Shattuckville	Frank S. Field	Massaemit Yarn Mills.
Somerville	Albert Birch	Birch Bros. Co.
South Boston	Robert Bishop	Robert Bishop Mfg. Co.
South Boston	W. L. Draper	253 A St.
Southbridge	Calvin D. Paige	Central Mills.
South Hadley Falls	Charles W. Dennett	So. Hadley Mills.
South Hadley Falls	Harlan Ingalls Dennett	Hadley Mills.
Springfield	Joseph M. Dunham	43 Edwards St.
Spring Hill	Justin A. Ware	
Taunton	A. C. Bent	Safety Seamless Pocket Co.
Taunton	William H. Bent	Mason Machine Works.
Taunton	Raymond D. Borden	Watuppa Mills.
Taunton	Peter H. Corr	Greenwich Bleachery.
Taunton	Thomas G. Cox	Mason Machine Works.
Taunton	H. H. Culver	Elizabeth Poole Mills.
Taunton	Henry S. Culver	Westville Cotton Mills.
Taunton	S. L. Gabriel	U. S. Linen Co.
Taunton	Henry M. Lovering	Whittenton Manufg. Co.
Taunton	Charles L. Macomber	Winthrop Cotton Yarn Co.
Taunton	John Tempest Meats	Mason Machine Works.
Taunton	Herbert H. Shumway	
Taunton	Henry Williams	Canoe River Mill.
Taunton	Elias S. Willis	N. E. Cotton Yarn Co.
Thorndike	Charles A. Tabor	Thorndike Co.
Three Rivers	Roscius C. Newell	Otis Co.
Three Rivers	Frederick A. Upham	Palmer Mill, Otis Co.
Turners Falls	Samuel L. Parker	Turners Falls Cotton Mills.
Waltham	Charles E. Getchell	Waltham Emery Wheel. Co.
Waltham	Arthur H. Paul	Boston Mfg. Co.

Ware	George E. Tucker	The Otis Co.
Webster	Frank Hartley	S. Slater & Sons.
Webster	E. P. Morton	Stevens Linen Works.
Webster	William J. Stewart	S. Slater & Sons Inc.
Westfield	E. T. Fowler	Foster Machine Co.
Westfield	W. H. Jillson	Mfr. Cotton Yarns.
West Warren	A. G. Harris	West Warren Cotton Mills.
West Warren	George A. Moody	West Warren Cotton Mills.
Whitinsville	Alfred E. Adams	Whitinsville Cotton Mills and Linwood Mills.
Whitinsville	Melvin H. Coffin	Whitin Machine Works.
Whitinsville	James A. Cooper	Whitin Machine Works.
Whitinsville	Lawrence M. Keeler	Whitin Machine Works.
Whitinsville	Josiah M. Lasell	Whitin Machine Works.
Whitinsville	E. Kent Swift	Whitin Machine Works.
Whitinsville	Oscar L. Owen	Whitin Machine Works.
Whitinsville	Elwin H. Rooney	The Whitin Machine Works.
Whitinsville	Arthur F. Whitin	Saunders Cotton Mills.
Whitinsville	G. Marston Whitin	Whitin Machine Works.
Whitinsville	James Earle Whitin	Uxbridge Cotton Mills.
Williamstown Sta.	Roland R. Kelly	Williamstown Manufg. Co.
Woburn	William W. Crosby	8 Court St.
Worcester	George L. Brownell	Inventor and Builder of Improved Twisting Machinery.
Worcester	George Crompton	Crompton-Thayer Loom Co.
Worcester	Randolph Crompton	Crompton-Thayer Loom Co.
Worcester	Henry F. Harris	W. Boylston Mfg. Co.
Worcester	Lewis T. Houghton	89 Exchange St.
Worcester	A. H. Howard	Howard Bros. Mfg. Co.
Worcester	C. H. Hutchins	Crompton & Knowles Loom Works
Worcester	Edwin H. Marble	Curtis & Marble Machine Co.
Worcester	Edwin T. Marble	Curtis & Marble Machine Co.
Worcester	Geo. I. Rockwood	62 Summer St.
Worcester	Wm. B. Scofield	Crompton-Thayer Loom Lo.
Worcester	Harry M. Smith	
Worcester	W. W. White	Holyoke Machine Co.

RHODE ISLAND.

Albion	Arnold B. Chace	Valley Falls Co.
Alton	Charles W. Shepard	Alton Mfg. Co.
Allenton	R. A. Gray	Rodman Manufg. Co.
Anthony	Frank F. Woolley	Coventry Co.
Ashton	Charles H. Collins	Berkeley Co.
Ashton	Robert Stewart	Lonsdale Co.
Bristol	Ezra Dixon	Dixon Lubricating Saddle Co.
Central Falls	Louis B. Barker	United States Cotton Co.

Central Falls	David Grove	United States Cotton Co.
Central Falls,	B. F. G. Linnell,	Yarns, Threads and Twines.
Centreville	James T. Ferguson	Warwick Mills.
Crompton	Charles D. Robinson	Crompton Co.
East Greenwich	H. M. Peirce	Greenwich Bleachery.
Fiskville	James Gee	Interlaken Dye Works.
Forestdale	William B. Orr	Forestdale Mfg. Co.
Forestdale	Alphonso F. White	Forestdale Mfg. Co.
Georgiaville	A. E. Bosworth	Bernon Mills.
Hamilton	Joseph Warren Greene	Hamilton Web Co.
Longmeadow	Abel T. Atherton	Machine Maker.
Lonsdale	Edward A. Mongeon	Lonsdale Mills.
Lonsdale	R. Irving Tobey	
Manville	A. Tenny White	Manville Co.
Natick	Andrew W. McAllister	
Natick	John G. McFadden	Natick Mills.
Pawtucket	V. T. Barber	Slater Cotton Co.
Pawtucket	Harold C. Barnefield	Hays Textile Co.
Pawtucket	William Washington Blades,	Lorraine Mfg. Co.
Pawtucket	E. R. Bullock	J. & P. Coats, Ltd.
Pawtucket	Robert Burgess	Burgess Mills.
Pawtucket	Benjamin C. Chace Jr.	Jenckes Spinning Co.
Pawtucket	A. Lockwood Danielson	Slater Cotton Co.
Pawtucket	William P. Dempsey	Dempsey Bleachery & Dye Works.
Pawtucket	Henry C. Dexter	Greene & Daniels Mfg. Co.
Pawtucket	Fred W. Easton	Easton & Burnham Machine Co.
Pawtucket	D. A. Everly	Cotton Mfr.
Pawtucket	Lyman B. Goff	Union Wadding Co.
Pawtucket	William Halliwell	Ingrahamville Dye Works.
Pawtucket	Charles E. Harrison	Harrison Yarn and Dyeing Co.
Pawtucket	David Jackson	Jackson Pat. Shell Roll Co.
Pawtucket	J. E. Jenckes	The E. Jenckes Manufg. Co.
Pawtucket	Albert A. Jenks	Fales & Jenks Machine Co.
Pawtucket	John T. Kirk	Slater Cotton Co.
Pawtucket	James R. MacColl	Lorraine Manufg. Co.
Pawtucket	Frederick R. Mason	The Robert D. Mason Co.
Pawtucket	Edward J. McCaughey	Home Bleach & Dye Works.
Pawtucket	James C. Potter	Potter & Johnson Co.
Pawtucket	Charles O. Read	Sayles' Bleacheries, and Glenlyon Dye Works.
Pawtucket	E. R. Richardson	Howard & Bullough American Machine Co., Ltd.
Pawtucket	Israel P. Rounds	Naushon Co.
Pawtucket	Frank A. Sayles	Sayles Bleacheries & Lorraine Mfg. Co.
Pawtucket	Dwight Seabury	12 East Ave.
Pawtucket	Charles S. Smith	Smith Webbing Co.

Pawtucket	W. H. Smith	American Textile Co.
Pawtucket	Jacob Stephans	William H. Haskell Mfg Co.
Pawtucket	Edward Thayer	Lebanon Mill Co.
Pawtucket	S. Willard Thayer	Dexter Yarn Co.
Pawtucket	William P. Wood	Royal Weaving Co.
Peace Dale	William C. Greene	Peace Dale Manufg. Co.
Phenix	Henry R. Brown	Phenix Mill.
Phenix	Robert Reoch	Cranston Print Works Co.
Providence	Charles T. Aldrich	Aldrich Manufg. Co.
Providence	John Ormsbee Ames	Fletcher Mfg. Co.
Providence	William Ames	Fletcher Mfg. Co.
Providence	George R. Babbitt	American Oil Co.
Providence	Edward R. Ballou	Ballou Yarn Co.
Providence	Edward R. Blanchard	Glenlyon Dye Works.
Providence	J. Frank Braids	Charles S. Bush Co.
Providence	H. Martin Brown	U. S. Bobbin & Shuttle Co.
Providence	E. C. Bucklin	Interlaken Mills.
Providence	Harris H. Bucklin	Interlaken Mills.
Providence	Granville R. Budlong	Union Wadding Co.
Providence	Charles H. Child	Standard Mill Supply Co.
Providence	Alfred M. Coats	J. & P. Coats, L't'd.
Providence	Frederick I. Dana	The Textile Machinery Finishing Co.
Providence	J. DeForest Danielson	Lockwood Co. and Lewiston Bleachery and Dye Works.
Providence	John W. Danielson	Lockwood Co., Ponemah Mills, Quinebaug Co., Wauregan Co., & Lewiston Bleachery & Dye Works.
Providence	Henry B. Deming	Deming Braiding Co.
Providence	Arthur W. Dennis	Elmwood Mills.
Providence	Jesse P. Eddy, Jr.	Tillinghast Stiles Co. and Fitch Mfg. Co.
Providence	F. C. Fletcher	Lawton Spinning Co.
Providence	J. Herbert Foster	10 South Water St.
Providence	Arthur C. Freeman	Textile Finishing Machinery Co.
Providence	William Gammell	Berkeley Co.
Providence	R. H. I. Goddard, Jr.	Goddard Bros.
Providence	Rufus B. Goff	Standard Mill Supply Co.
Providence	Russell Grinnell	General Fire Extinguisher Co.
Providence	John H. Hambly	Quidnick Mfg. Co.
Providence	A. Walter Harris	A. W. Harris Oil Co.
Providence	Alexander F. Hobbs	U. S. Finishing Co.
Providence	Frederic W. Howe	Crompton & Knowles Loom Works.
Providence	Albert C. Hoy	Grosvenor Dale Co.
Providence	Daniel Jackson	B. B. & R. Knight.
Providence	Albert F. Knight	1149 Elmwood Ave.
Providence	John E. Kendrick	American Supply Co.
Providence	Stephen A. Knight	Hebron Manufg. Co.

Providence	Webster Knight	B. B. & R. Knight's Mills.
Providence	W. C. Langford	14 Peck St.
Providence	Henry F. Lippitt	Social and Manville Cos.
Providence	Charles R. Makepeace	Box 973.
Providence	Henry W. Mason	10 South Water St.
Providence	F. H. Maynard	Gen. Fire Extinguisher Co.
Providence	Thomas Mayor	Thomas Mayor & Son.
Providence	Charles H. Merriman, Jr.	Manville Co.
Providence	William C. Peirce	Elizabeth Mills.
Providence	Stephen Minot Pitman	Narragansett Mutual Fire Ins. Co.
Providence	Charles A. M. Praray	Chas. A. M. Praray & Co.
Providence	E. A. Rusden	17 Exchange Place.
Providence	Robert Schaellibaum	Rob. Schaellibaum Co.
Providence	Arthur N. Sheldon	F. P. Sheldon & Co.
Providence	Frank P. Sheldon	Industrial Trust Building.
Providence	Antonio Spencer	Spencer Yarn Co.
Providence	Wilton H. Spencer	7 Exchange Place.
Providence	Daniel J. Sully	T. M. Reynolds & Co.
Providence	Robert W. Taft	Coventry Co.
Providence	Charles F. Taylor	Burgess Cop Tube Co.
Providence	James T. Thornton	Thornton Machinery Co.
Providence	H. A. Tillinghast	The Textile Finishing Machinery Co.
Providence	A. Curtis Tingley	National Ring Traveler Co.
Providence	W. O. Todd	Lawton Spinning Co.
Providence	Robert B. Treat	Manufacturers' Fuel Co.
Providence	William P. Vaughan	Putnam Mfg. Co.
Quidnick	Alton L. R. Hambly	Quidnick Mfg. Co.
Quidnick	O. B. Parker	Quidnick Mfg. Co.
Riverpoint	Arthur F. Brackett	
Saylesville	Charles F. Burnham	Crefeld Waste and Batting Co., and The L. A. Lockwood Co.
Saylesville	L. A. Lockwood	Crefeld Waste and Batting Co., and The L. A. Lockwood Co.
Sayesville	Kenneth F. Wood	Sayles Bleacheries.
Valley Falls	Malcolm G. Chace	Naushon Mfg. Co.
Valley Falls	Andrew J. Currier	
Valley Falls	Edward B. Jennings	Samoset Co.
Warren	Edward E. Bartlett	Parker Mills.
Warren	Arnold Schaer	Warren Manufg. Co.
Westerly	William Clark	Wm. Clark Mills, American Thread Co
Westerly	Robert Dow	Solway Mills.
Westerly	A. E. Henry	Solway Mills.
Westerly	Alexander King, Jr.	Amer. Thread Co.
Westerly	Robert B. Meikle	Lorraine Mfg. Co.
Westerly	Harry Tunstall	American Thread Co.
Woonsocket	L. W. Campbell	Woonsocket Machine and Press Co.
Woonsocket	Malcolm Campbell	Woonsocket Mach. & Press Co.

Woonsocket	Harry S. Greene	Woonsocket Napping Machinery Co.
Woonsocket	Henry S. Greene	Woonsocket Napping Machinery Co.
Woonsocket	William Halliwell	Providence and Woonsocket Mill. of the Lawton Spinning Co.
Woonsocket	Edward W. Houghton	Globe Mill, Manville Co.
Woonsocket	Henry S. Houghton, Sr.	74 Hamlet Ave.
Woonsocket	William N. Kimball	Social and Nourse Mills.
Woonsocket	Hadley D. Perkins	Bellingham Handkerchief Mfg. Co.
Woonsocket	Joseph G. Ray	The Putman Mfg. Co.
Woonsocket	Charles E. Thomas	44 Prospect St.
Woonsocket	Marcus J. Woodrow	Clinton Mfg. Co.

CONNECTICUT.

Baltic	Samuel T. Butterworth	Baltic Mills Co.
Baltic	William E. Peck	The Baltic Mills Co.
Danielson	Gordon A. Johnstone	Danielson Cotton Co.
Danielson	Frank Porter Jr.	Danielson Cotton Mill.
Danielson	James Herbert Smith	Quinebaug Co.
Jewett City	Frederick D. Ballou	W. A. Slater Mills.
Jewett City	James O. Sweet	Ashland Cotton Co.
Jewett City	Adelbert R. Young	Ashland Cotton Co.
Killingly	H. C. Atwood	Williamsville Manufg. Co.
Killingly	W. E. Atwood	Williamsville Manufg. Co.
Killingly	Ernest E. Clark	Williamsville Mfg. Co.
Killingly	C. H. Truesdell	Attawaugan Co.
Middletown	Benjamin Forster	384 Main St.
Middletown	Frank B. Gustafson	I. E. Palmer Cotton Spinning Mill.
Middletown	Joseph Merriam	Springfield Webbing Co.
Middletown	J. F. Powers	Spinning Mill.
Middletown	Fred Unger	I. E. Palmer Mills.
Montville	W. G. Hartford	Monarch Woolen Mills.
Montville	W. S. Trickett	Attawaugan Co.
Moosup	L. B. Cranska	Floyd Cranska Mills.
New Haven	George S. Barnum	The Bigelow Co.
Norwich	W. N. Blackstone	Attawaugan Co. and Totokett Mills Co.
Norwich	W. R. Burnham	362 Main St.
Norwich	C. H. Frisbie	Attawaugan Co. Arista Mills Co.
Norwich	W. G. Henderson	Falls Co.
Norwich	Wm. I. Woodward	Shetucket Co.
Norwich Town	Arthur H. Gulliver	P. O. Box 313.
Plainfield	Harold Lawton	The Lawton Mills Corp.
Putnam	George W. Holt	Monohansett Manufg. Co.
Putnam	George A. Vaughan	Putnam Manufg. Co.
Sterling	Harold Mowry	Br. U. S. Finishing Co.
Taftville	Joseph D. Aiken	Ponemah Mills.

Taftville	John Eccles	Ponemah Mills.
Uncasville	Robert G. McMeehan	Uncasville Mfg. Co.
Versailles	Charles W. Perkins	The Totokett Mfg. Co.
Voluntown	George T. Briggs	The Briggs Mfg. Co.
Waterbury	Archer J. Smith	The American Mills Co.
Wauregan	James A. Atwood	Wauregan Co. & Quinebaug Co.
Wauregan	John Walter Atwood	Wauregan Co.
Willimantic	Dickerson G. Baker	American Thread Co.
Willimantic	E. S. Boss	American Thread Co.
Willimantic	John L. Burton	Willimantic Cotton Mills.
Willimantic	Peter Hardman	American Thread Co., Willimantic Mills.
Willimantic	Walter B. Knight	Windham Mfg. Co.
Willimantic	Joseph Mercer	Willimantic Cotton Mills Co.
Windsor Locks	George M. Montgomery	The J. R. Montgomery Co.
Windsor Locks	J. R. Montgomery	The J. R. Montgomery Co.

NEW YORK.

Brooklyn	Hugh De Haven	De Haven Mfg Co.
Capron	W. H. Cloher, Jr.	Utica Cotton Co.
Chadwicks	Bradford C. Divine	Utica Willowvale Bleaching Co.
Cohoes	David S. Johnston	Harmony Mills.
Cohoes	Henry C. Phillips	Harmony Mills.
Cohoes	William H. Robinson	No. 3 Harmony Mill.
Delhi	Dudley T. Lyall	
Elmira	William H. Bilbrough	Elmira Knitting Mills and Conewawah Spinning Co.
Jamestown	Thomas Henry Smith	Jamestown Cotton Mill.
Newburgh	William J. Hadfield	Harrison & Gore Silk Mills.
New York City	Robert Franklin Adams	106 Grand St.
New York City	George Arms	Grand Hotel.
New York City	Edwin H. Baker	Bliss, Fabyan & Co.
New York City	D. C. Ball	5 Beekman St.
New York City	Percy H. Brundage	49 Wall St.
New York City	Albert C. Case	5 Nassau St.
New York City	Charles F. Chase	Cling Surface Co.
New York City	J. E. Cheesman	Cheesman Cotton Gin Co.
New York City	C. C. Cowan	27 William St.
New York City	Charles Henry Davis	25 Broad St.
New York City	L. L. Flemming	American Cotton Co.
New York City	E. C. Foerster	415 Broadway.
New York City	Samuel T. Hubbard	Hubbard Bros. & Co.
New York City	William M. Lovering	24 Thomas St.
New York City	Arthur B. Mann	J. H. Martin & Co.
New York City	John R. Mitchell	Mitchell-Bissell Co.
New York City	Fred Moss	495 Broome St.

New York City	Hugh Nelson	Casualty Co. of America.
New York City	Charles H. Newman	Webster Mfg. Co.
New York City	Arthur Parkinson	Arabol Mfg. Co.
New York City	Chas. F. Pray	Cloth Broker.
New York City	Theodore H. Price	Cotton Dealer.
New York City	William N. Shaw	The Lincoln Iron Works & Jackson Architectural Iron Works.
New York City	Clarence Whitman	Wilkesbarre Lace Mfg. Co.
New York City	Arthur Whittam	James E. Mitchell Co.
New York City	George A. Wies	Eureka Fire Hose Co.
New York Mills	Obadiah Butler	New York Mills.
New York Mills, Oneida Co.,	J. B. Bolton	New York Mills.
New York Mills, Oneida Co.,	John P. Campbell,	New York Mills.
New York Mills, Oneida Co.,	Lavater W. Powers,	New York Mills.
Oswego	George E. Farrell	Ontario Knitting Co.
Oswego	James G. Merriman, Jr.	Standard Spinning Co.
Perry	Robert A. Copeland	Perry Knitting Co.
Perry	George M. Traber	The Perry Knitting Co.
Suffern	Stewart F. Carter	Atlantic Fibre Co.
Utica	John W. Allis	Utica Knitting Co.
Utica	George DeForest	Utica Steam and Mohawk Valley Cotton Mills.
Utica	James B. Duggan	41 Jewett Place.
Utica	D. W. Gray	Manager La Tosca Spinning Co.
Utica	Charles Hayes Jr.	Skenandoa Cotton Co.
Utica	Henry F. Mansfield	Utica Steam Cotton Mills and Mohawk Valley Cotton Mills.
Utica	R. P. McLoughlin	La Tosca Yarn Mill.
Utica	Pardon B. Sanford	Utica Kniting Co.
Utica	Albion K. Searls	Oneita Knitting Mills.
Utica	John B. Wild	Oneita Knitting Mills.
Utica	Rex G. Witherbee	Utica Steam and Mohawk Valley Cotton Mills.

NEW JERSEY.

Atlantic City	Franklin P. Stoy	817 Pacific Ave.
Beverly	Alban Spooner	Beverly Underwear Co.
East Newark	Halsey Connett	Clark Mile End Spool Cotton Co.
East Newark	Adam H. Groel	Clark Mile End Spool Cotton Co.
Gloucester City	George W. Grove	Argo Mills Co.
Gloucester City	Jesse A. Knight	Argo Mills Co.
Gloucester City	George W. Turner	Argo Mills Co.
Jersey City	Ernest Bridge	Jas. Chadwick & Bro. Ltd.
Jersey City	Maxwell Grierson	Jas. Chadwick & Bro., Ltd.
Jersey City	B. L. Stowe	Eureka Fire Hose Co.
Millville	John F. Reardon	Millville Mfg. Co.

Newark	William H. Loftus	Clark Thread Co.
Newark	Lewis H. Russell	Norfolk St. and Sussex Ave.
New Brunswick	William Henry Hobbs	Johnson & Johnson Co.
Passaic	William L. Lyall	Brighton Mills.
Paterson	J. E. Barbour	Barbour Flax Spinning Co.
Paterson	John W. Ferguson	Paterson Nat. Bank Bldg.
Trenton	Edward C. Stokes	

PENNSYLVANIA.

Chester	William S. Blakeley	Arashapa Co.
Chester	John W. France	The Aberfoyle Mfg. Co.
Chester	W. T. Galey	Aberfoyle Manufg. Co.
Chester	D. Edwin Irving	The Irving & Leiper Manufg. Co.
Chester	Robert F. Kineavy	Arasapha Mfg. Co.
Chester	John William Smith	T. I. Birkin & Co.
Chester	D. Irving Trainer	Lincoln Mfg. Co.
Frankford, Phila.	Walter R. Garsed	Wingohocking Cotton Mills.
Mt. Joy	Thomas J. Brown	George Brown's Sons.
North Wales	Maylin Hamburger	Montgomery Mills.
Philadelphia	Bradley C. Algeo	Philadelphia Textile School.
Philadelphia	Robert Beatty	Robt. Beatty & Co.
Philadelphia	Robert C. Blood	7th and Somerset Sts.
Philadelphia	T. Ashby Blythe	Ashby Cotton Mills.
Philadelphia	Joseph H. Bromley	Fourth and Lehigh Ave.
Philadelphia	Alfred H. Burnham	Glasgow Mills.
Philadelphia	Harry W. Butterworth	H. W. Butterworth & Sons.
Philadelphia	James Butterworth	H. W. Butterworth & Sons.
Philadelphia	E. G. Chester	Cedar and Huntingdon Sts.
Philadelphia	H. M. Daniel	The Mayo Mills and The Avalon Mills.
Philadelphia	Frederick A. Downes	Keystone Mutual Fire Insurance Co.
Philadelphia	Edward W. France	Philadelphia Textile School.
Philadelphia	Simon Friedberger	Friedberger Mfg. Co.
Philadelphia	Otto Goetze	Glasgow Mills, Kensington Station.
Philadelphia	John T. Greenwood	R. Greenwood & Bault.
Philadelphia	Henry S. Grove	Argo Mills Co.
Philadelphia	James Henry	Thomas Henry & Sons.
Philadelphia	William G. Henry	Thomas Henry & Sons.
Philadelphia	Robert P. Hooper	Hooper Sons Mfg. Co.
Philadelphia	W. C. Houston	Hope Mills Mfg. Co.
Philadelphia	Oliver N. Long	Long Bros. Co.
Philadelphia	John H. Lorimer	Ontario and Lawrence Sts.
Philadelphia	J. Franklin McFadden	George H. McFadden & Bro.
Philadelphia	David H. McKinley	Philadelphia Thread Co.
Philadelphia	Simon Miller	16th & Reed Sts.
Philadelphia	David Milne	Washington Ave and 10th & 11th Sts.
Philadelphia	Edward H. Sanborn	Cold Spring Bleach. & Fin. Works.

Philadelphia	Albert E. Schofield	Delph Spinning Co.
Philadelphia	W. A. Spellissy	Dolier & Co., Mariner and Merchants' Building.
Philadelphia	Paul E. Sutro	E. Sutro & Son.
Philadelphia	William L. Turner	North American Lace Co.
Philadelphia	Joseph Wasserman	Philadelphia Tapestry Mills.
Philadelphia	William T. Westerman	Ontario Spinning Co.
Philadelphia	James S. Whitaker	William Whitaker & Sons.
Philadelphia	E. Wilkinson Jr.	E. Wilkinson & Son.
Philadelphia	George Wood	Millville Mfg. Co.
Philadelphia	John P. Wood	521 N. 22nd St.
Philadelphia	Oscar W. Wood	Germantown Spinning Co.
Pittsburgh	Roland Gerry	Jones & Laughlin Steel Co.
South Bethlehem	Frederick Ott	Lehigh Valley Silk Mills.
Yardley	Theodore C. Search	Cold Spring Bleaching and Finishing Works.

DELAWARE.

Wilmington	Daniel Moore Bates	Joseph Bancroft & Sons Co.
Wilmington	John B. Bird	Joseph Bancroft & Sons Co.

MARYLAND.

Baltimore	E. Stanley Gary	Gary Mfg. Co.
Baltimore	James A. Gary	Gary Mfg. Co.
Baltimore	Arthur N. Hersom	Mt. Vernon Mills.
Baltimore	Wm. E. Hooper	Woodberry Division of Mt. Vernon Woodberry Co.
Baltimore	Charles K. Oliver	U. S. Duck Corporation.
Baltimore	E. W. Thomas	Consolidated Cotton Duck Co.
Baltimore	Charles W. Wood	U. S. Cotton Duck Corporation.
Ilchester	Samuel F. Patterson	Thistle Mills Co.

VIRGINIA.

Danville	George W. Robertson	Dan River Cotton Mills.
Emporia	W. T. Tillar	The Ashby Cotton Mill Co., Inc.

NORTH CAROLINA.

Asheville	Henry Rowe	Elk Mountain Bleachery.
Charlotte	E. N. Clemence	
Charlotte	Stewart W. Cramer	The Whitin Machine Works and Wooonsocket Machine & Press Co.
Charlotte	Arthur J. Draper	Hoskins, Louise, Calvine and Dover Yarn Mills.

Charlotte	Edward T. Garsed	
Charlotte	R. M. Miller, Jr.	Elizabeth Mills.
Charlotte	Daniel A. Tompkins	D. A. Tompkins Co.
Charlotte	Frank S. Tucker	Westinghouse Elec. and Mfg. Co.
Cooleeme	Henry J. Forsyth	Cooleeme Cotton Mill.
Fayetteville	Frank H. Cotton	
Fayetteville	Walter L. Holt	Holt-Morgan Mills.
Greensboro	Caesar Cone	Proximity Mfg. Co.
Greensboro	Farquharson J. Muir	Cone Export & Commission Co.
Lincolnton	R. S. Reinhardt	Elm Grove Cotton Mills.
Lincolnton	James W. Taylor	Wampum Mills.
Mountain Island	W. T. Jordan	Mt. Island Manufg. Co.
Spray	Aaron C. Phelps	German-American Co.
Winston-Salem	John W. Fries	F. & H. Fries. & Arista Mills Co.

SOUTH CAROLINA.

Clemson College	Charles S. Doggett	Clemson College.
Columbia	Wallace L. Ball	Columbia Mills Co.
Columbia	Louis I. Guion	Columbia Mills Co.
Columbia	W. H. Rose	Richland, Granby & Olympia Cotton Mills.
Graniteville	T. H. Rennie	Graniteville Mfg. Co.
Lancaster	Leroy Springs	Lancaster Cotton Mills.
Langley	Arthur T. Smith	Langley Manufg. Co. and Aiken Manufg. Co.
Newberry	Edward B. Wilbur	Mollohon Mfg. Co.
Ware Shoals	W. C. Cobb	Ware Shoals Mfg. Co.
Union	William P. Heineken	Union Mfg. and Power Co.
Union	Hartley L. Lord	Union-Buffalo Mills Co.
Warrenville	William H. Rennie	Supt. Warren Mfg. Co.

GEORGIA.

Atlanta	Harry K. Drew	Fulton Bag and Cotton Mills.
Atlanta	Oscar Elsas	Fulton Bag and Cotton Mills.
Atlanta	Henry E. Fisher	Atlanta Cotton Mills.
Augusta	Thomas Barrett, Jr.	Langley & Aiken Mills.
Augusta	John W. Chafee	The Sibley Mfg. Co.
Augusta	T. I. Hickman	Graniteville Mfg. Co.
Augusta	Peleg A. Rhodes	Cotton Mill Mutual Fire Ins. Co.
Augusta	Joel Smith	1311 Woodlawn Ave.
Augusta	George R. Stearns	Riverside Mills.
Chattahoochee	W. R. B. Whittier	Whittier Mills.
Columbus	Frederick B. Gordon	Columbus Mfg. Co.

Columbus	Charles H. Gorton	Columbus Mfg. Co.
Columbus	Walter Rigby	Bibb Mfg. Co.
Columbus	George W. Towne	Bibb Mfg. Co.
Commerce	Charles M. Sears	Harmony Grove Mills.
East Point	Edward C. Beach	Gate City Cotton Mills.
Lawrenceville	C. Enos Bean	Lawrenceville Mfg. Co.
Lindale	Henry P. Meikleham	Mass. Mills in Georgia.
Macon	Henry C. Dresser	Bibb Mfg. Co.
Macon	H. B. Hopson	Bibb Mfg. Co.
Macon	Logan Owen	Bibb Mfg. Co. Mill No. 1.
Macon	Broadus E. Willingham	Willingham Cotton Mills.

TENNESSEE.

Knoxville	William T. Lang	Brookside Mills.
Memphis	William Dresser Edwards	Randolph Bldg.

ILLINOIS.

Rockford	Howard D. Colman	Barber-Colman Co.

MISSISSIPPI.

Agricultural College	William E. Winchester	Mississippi Textile School.
Starkville	J. D. Mailory	John M. Stone Cotton Mill.

LOUISIANA.

New Orleans	S. Odenheimer	Lane-Maginnis Mills Corp.

KENTUCKY.

Henderson	Paul J. Marrs	Henderson Cotton Mills.
Louisville	O. W. Stites	Louisville Cotton Mills Co.
Louisville	Philip S. Tuley	Louisville Cotton Mills Co.

ALABAMA.

Cordova	Scott Maxwell	Indian Head Mills of Ala.
Pell City	James R. Pearce	Pell City Mfg. Co.
Tallassee	Byron F. Card	Tallassee Falls Mfg. Co.
Tallassee	William E. Elsberry	Tallassee Falls Mfg. Co.

WISCONSIN.

St. Croix Falls	Arthur W. Hunking	Stone & Webster.

CALIFORNIA.

Los Angeles	William Warr	Pacific Electrical Bldg.

CANADA.

Province of Ontario.

Cornwall	William V. Boyd	Canadian Col'd Cotton Mills Co. Ltd.
Cornwall	S. Greenwood	Canadian Colored Cotton Mills Co., Ltd.
Hamilton	George O. Dexter	Canadian Colored Cotton Mills Co., Ltd.
Hamilton	James M. Young	Hamilton Cotton Co.

Province of Quebec.

Montreal	James H. Brand, Jr.	201 Board of Trade Building.
Montreal	C. B. Gordon	Dominion Textile Co., Ltd.
Montreal	Alfred Hawkesworth	Alfred Hawkesworth & Sons, Ltd.
Montreal	Fred Hawkesworth	Alfred Hawkesworth & Sons, Ltd.
Montreal	D. K. McLaren	751 Craig St.
Montreal	A. B. Mole	Dominion Cotton Mills Co.
Montreal	W. T. Whitehead	Dominion Textile Co.
Valleyfield	Charles H. Potter	Montreal Cotton Co.
Valleyfield	Louis Simpson	Montreal Cotton Co.
Valleyfield	Lewis J. Young	Montreal Cotton Co.

NEW BRUNSWICK.

St. John	John B. Cudlip	Cornwall and York Cotton Mills Co.
New Brunswick	J. Whidden Graham	Canadian Col'd Cotton Mill Co., Ltd.
New Brunswick	W. H. Macdonald	Canadian Col'd Cotton Mill Co. Ltd.

ENGLAND.

Cheshire	William Myers	Lecturer in Textiles.
Huddersfield	John Sykes	English Card Clothing Co.
Matlock, Derbyshire,	John Edward Lawton	American Thread Co.
Oldham	Robert Taylor Jr.	Soho Iron Works.

GERMANY.

Berlin	William F. Parish, Jr. . .	Vacuum Oil Co.

RUSSIA.

Moscow	Vladimir F. Gnesin . . .	The Great Yaroslavl Mfg. Co.
Moscow	Vladimir Malinin	Prochoroff Three Hill Mfg. Co.

JAPAN.

Hiogo	Hachiro Henry Fukuhara .	Sumoto Mill, Kanegafuchi Spinning Co.

RECAPITULATION.

LOCATION OF MEMBERSHIP.

Maine	18
New Hampshire	29
Vermont	3
Massachusetts	417
Rhode Island	150
Connecticut	47
New York	57
New Jersey	18
Pennsylvania	51
Delaware	2
Maryland	8
Virginia	3
North Carolina	18
South Carolina	13
Georgia	22
Tennessee	2
Wisconsin	1
Illinois	1
Mississippi	2
Louisiana	1
Kentucky	3
Alabama	4
California	1
Province of Ontario	4
Province of Quebec	10
New Brunswick	3
England	4
Germany	1
Russia	2
Japan	1
	896

IN MEMORIAM.

RICHARD B. BORDEN.

RICHARD B. BORDEN was one of the earliest members of this Association which he joined July 19, 1865, and died at his home in Fall River, October 12, 1906.

He was born at Fall River, February 21, 1834, and was the son of RICHARD BORDEN, one of the founders in cotton manufacturing in that city. During his long life he was actively engaged in cotton manufacturing, holding executive offices in a number of the mills, and since 1876 was treasurer of the Richard Borden and the Troy Mills. He was also, as director or vice-president, connected with a number of banks and insurance companies.

He was probably for a longer time connected with cotton manufacturing than any other man in Massachusetts.

In the technical side of business he was thoroughly practical and closely in touch with all the improvements of methods and processes, and also as a financier was of signal ability.

He was a man of the highest integrity in life and commanded the respect of the community to a remarkable degree.

He was married in 1863 to ELLEN F. PLUMER of Boston, by whom he is survived, and also leaves two sons and two daughters.

CHARLES H. HOBBS.

CHARLES H. HOBBS died at Thorndike, October 2, 1906, after an illness of several weeks.

He was born at Norway, Me., September 15, 1848, and began at the Bates Mill, Lewiston, Me., where later he became superintendent. From there he went to Cornwall, Ontario, in a similar position, and later to Slatersville, R. I. He became agent of the Thorndike Company's mill in 1889, and also took charge of the West Warren Mills in 1898.

He took keen interest in public affairs but was averse to holding office.

He was a member of several societies and clubs, president of the Farmer National Bank and a director in two other banks.

He leaves a widow and one son.

He became a member of this Association April 28, 1886.

RICHARD THACKERAY.

RICHARD THACKERAY died at his home in Fall River, Mass., September 17, 1906, after an illness of five weeks.

He was born in Barnsley, England, in 1835. Came to this country early in life and was always engaged in cotton manufacturing. He was connected with the Weetamoe Mills when they were built in 1871, and eleven years after became superintendent, which place he always held. He was a thorough manufacturer, especially skilled in weaving, and a man of sterling worth and integrity.

His wife died some years ago and he is survived by a son and three daughters.

He became a member of this Association April 29, 1885.

DAVID M. THOMPSON.

DAVID M. THOMPSON, president of this Association from 1900 to 1901, died at his home in Providence, R. I., June 28,

1906, closing a career of notable activity in cotton manufacturing. He was born at Great Falls, N. H., April 10, 1889, where his father was connected with the cotton mills of that place and from his earliest boyhood he spent the time out of his school hours; and later, when he entered active life, he was engaged in connection with the processes of bleaching and finishing, as well as those of cotton manufacturing.

Later he learned the carpenter's trade and became master mechanic in the mills at Manville, R. I. After he severed his connection with the Whitin Machine Works he formed a partnership as a carpenter and contractor at Portland, and later at Boston, in which places he built a number of large buildings. From this he became a contractor for mill buildings and after a trip to Europe, he established a large mill engineering office in Providence, R. I. In addition to the construction of mills in New England, he was for many years the leading designer of cotton mills at the South and did a great deal towards the establishment of modern mill buildings in that section.

In 1883 he became the general manager for the firm of B. B. & R. Knight, taking charge of the engineering work and reconstruction of their twenty-one mills and bleachery and print works. He left this position, after twelve years service, to take charge of the Corliss Steam Engine Works, which he had bought with some of his associates, but when these were sold he resumed service with B. B. & R. Knight, with which firm he was connected at the time of his death.

Mr. THOMPSON was endowed with a vigorous body which sustained an active mind to the application of untiring labors. He was closely allied with public affairs in the city of Providence, taking a prominent position in its Board of Trade; was the projector of certain boulevards in the southern portion of the city; formed an organization which was termed the Advance Club, in which were affiliated the active interests of some of the leading citizens of Providence for the advancement of that city, among which the most important was that of the improvement of the railroad facilities resulting in the Union Station of that city.

As president of this Association, he gave his accustomed energy to the interests of the organization which he joined on October 28, 1885. In addition to his addresses as president, he made a contribution on Covering for Cotton, and frequently joined in discussions upon other papers.

He leaves a widow and one daughter.

TRANSACTIONS.

In accordance with legal notice, the stated semi-annual meeting of the Association, being meeting No. 81 and the first meeting held since the change of the name of the Association from New England Cotton Manufacturers' Association to The National Association of Cotton Manufacturers, was held at Hotel Champlain, Clinton County, N. Y., on Wednesday and Thursday, September 12 and 13, 1906.

The following 94 members and 104 guests were present.

MEMBERS.

THOMAS ARMSTRONG,
H. C. ATWOOD,
GEORGE A. AYER,
ROBERT BEATTY,
ORIN F. BENNETT,
F. H. BISHOP,
CHARLES A. BOWEN,
JAMES H. BRAND, Jr.
HENRY GORDON BRINCKERHOFF,
CHRISTOPHER P. BROOKS,
ROBERT BURGESS,
CHARLES B. BURLEIGH,
HARRY W. BUTTERWORTH,
SAMUEL T. BUTTERWORTH,
MELVIN H. COFFIN,
HOWARD D. COLMAN,
REUBEN A. COOKE,
JAMES A. COOPER,
ROBERT A. COPELAND,
DANIEL J. DANKER,
HARLAN INGALLS DENNETT,
HENRY C. DEXTER,
LEWIS DEXTER, Jr.
FREDERICK N. DILLON,
C. E. W. DOW,
GEORGE OTIS DRAPER,
JOHN ECCLES,
JESSE P. EDDY, Jr.,
G. B. EMMONS,
D. D. FELTON,
JOHN A. FERNLEY,
GEORGE FISH,
M. F. FOSTER,
E. T. FOWLER,

H. P. Garland,
Roland Gerry,
Vladimir F. Gnesin,
George P. Grant, Jr.,
D. W. Gray,
William D. Hartshorne,
Arthur A. Haserick,
Edgar F. Hathaway,
Charles Hayes, Jr.,
George W. Holt,
William E. Hooper,
Frederic W. Howe,
Joseph B. Jamieson,
David S. Johnstone,
Frank B. Kenney,
Joseph C. King,
Stephen A. Knight,
John H. Lawrence,
William H. Loftus,
Harry D. Lord,
Arthur H. Lowe,
William L. Lyall,
James R. MacColl,
Rowland N. Mackay,
Frederick B. Macy,
Henry F. Mansfield,
Edwin H. Marble,
John P. Marston,
Thomas Mayor,
Meldon H. Merrill,
James G. Merriam, Jr.,
R. M. Miller, Jr.,
A. B. Mole,
J. R. Montgomery,
Charles B. Moore,
Hugh Nelson,
William R. Noone,
Oscar L. Owen,
Sidney B. Paine,
Frank W. Reynolds,
Richard H. Rice,
J. L. Sanford,
Pardon B. Sanford,
Robert Schaellibaum,
Lewis Shurtleff,
Louis Simpson,
Abbott P. Smith,
Harry M. Smith.
Wallace I. Stimpson,
James Strang,
James O. Sweet,
Rienzi W. Thurston,
George A. Vaughan,
Clement A. Wakefield,
William T. Westerman,
W. W. White,
John K. Whittier,
John B. Wild,
C. J. H. Woodbury,
Adelbert A. Young.

GUESTS.

C. W. Atwood, Killingly, Conn.
Joseph A. Baker, Fall River, Mass.
C. H. Barclay, Boston, Mass.
Howard W. Bible, New York City.
C. B. Bidwell, Atlanta, Ga.
H. D. Bowker, Milford, Mass.

T. E. Burleigh, Boston, Mass.
Frank H. Burt, Newton, Mass.
Samuel S. Butterworth, Baltic, Conn.
H. A. Cameron, Boston, Mass.
C. H. Clark, New York City.
S. S. Dale, Boston, Mass.
M. H. Dorman, New York City.
Walter F. Eayrs, Providence, R. I.
Nicolas P. Fedoroff, St. Petersburg, Russia.
J. B. Felton, Manchester, N. H.
Myron Fish, Providence, R. I.
H. W. Garcelon, Boston, Mass.
Harold C. Hansen, New York City.
Isaac Hartshorne, Lawrence, Mass.
M. A. Hays, New York City.
Carroll Hutchins, Boston, Mass.
F. S. Jewett, Providence, R. I.
Hamilton Johnston, Cohoes, N. Y.
F. L. Laird, New York City.
John Martin, Paris, Texas.
Julius M. Mayer, Albany, N. Y.
Frank L. Nagle, Boston, Mass.
W. C. Nairn, Lawrence, Mass.
James F. Owens, Lowell, Mass.
J. B. Perkins, Boston, Mass.
E. M. Reed, Fitchburg, Mass.
E. S. Rhodes, Providence, R. I.
Charles Robbins, New York City.
Frank E. Shedd, Boston, Mass.
A. E. Sproul, Boston, Mass.
Walter H. Stearns, Providence, R. I.
George F. Steele, Boston, Mass.
S. H. Steele, New York City.
Henry H. Sullivan, Boston, Mass.
Percy Walker, New York City.
John Wallace, Easthampton, Mass.
Talcott Williams, Philadelphia, Pa.
Mrs. H. C. Atwood, Killingly, Conn.
Mrs. George A. Ayer, Easthampton, Mass.

Miss Sadie M. Ayer, Easthampton, Mass.
Mrs. Robert Beatty, Philadelphia, Pa.
Mrs. Charles A. Bowen, New Bedford, Mass.
Mrs. H. D. Bowker, Milford, Mass.
Mrs. Henry Gordon Brinckerhoff, Boston, Mass.
Mrs. Robert Burgess, Pawtucket, R. I.
Mrs. Charles B. Burleigh, Boston, Mass.
Mrs. Clara A. Burnap, Windsor Locks, Conn.
Miss Grace M. Burt, Newton, Mass.
Mrs. Harry W. Butterworth, Philadelphia, Pa.
Mrs. E. H. Chamberlain, New Bedford, Mass.
Mrs. C. H. Clark, New York City.
Miss Josephine Clark, New York City.
Mrs. James A. Cooper, Whitinsville, Mass.
Mrs. S. S. Dale, Boston, Mass.
Mrs. Frederick N. Dillon, Fitchburg, Mass.
Miss Rebecca F. Doane, Milford, Mass.
Mrs. John Eccles, Taftville, Conn.
Mrs. Jesse P. Eddy, Jr., Providence, R. I.
Mrs. D. D. Felton, Manchester, N. H.
Mrs. Myron Fish, Providence, R. I.
Mrs. M. F. Foster, Milford, N. H.
Mrs. E. T. Fowler, Westfield, Mass.
Mrs. Edgar F. Hathaway, Boston, Mass.
Mrs. Charles Hayes, Jr., Utica, N. Y.
Mrs. George W. Holt, Putnam, Conn.
Miss Mary F. Holt, Putnam, Conn.
Mrs. F. S. Jewett, Providence, R. I.
Mrs. David S. Johnston, Cohoes, N. Y.
Mrs. John E. Kendrick, Providence, R. I.
Mrs. Frank B. Kenney, Lowell, Mass.
Mrs. Stephen A. Knight, Providence, R. I.
Miss Mary Knoblack, Buttonwoods, R. I.
Mrs. John H. Lawrence, New Bedford, Mass.
Mrs. W. H. Loftus, Newark, N. J.
Mrs. Arthur H. Lowe, Fitchburg, Mass.
Miss Margaret Lowe, Fitchburg, Mass.
Mrs. Frederick B. Macy, New Bedford, Mass.
Mrs. Edwin H. Marble, Worcester, Mass.
Miss Annie Mayor, Providence, R. I.

Mrs. J. R. Montgomery, Windsor Locks, Conn.
Mrs. Frank L. Nagle, Boston, Mass.
Mrs. Oscar L. Owen, Whitinsville, Mass.
Mrs. Frank W. Reynolds, Boston, Mass.
Mrs. E. S. Rhodes, Providence, R. I.
Mrs. Pardon B. Sanford, Utica, N. Y.
Mrs. Frank E. Shedd, Boston, Mass.
Mrs. Harry M. Smith, Providence, R. I.
Mrs. A. E. Sproul, Boston, Mass.
Mrs. George F. Steele, Boston, Mass.
Mrs. Wallace I. Stimpson, Hopedale, Mass.
Miss Helen Stout, New York City.
Mrs. Rienzi W. Thurston, Fall River, Mass.
Miss Florence Westerman, Philadelphia, Pa.
Mrs. William T. Westerman, Philadelphia, Pa.
Mrs. W. W. White, Worcester, Mass.
Mrs. John K. Whittier, Lowell, Mass.
Miss Helen Williams, Milford, Mass.
Miss Alice P. Woodbury, Lynn, Mass.
Mrs. C. J. H. Woodbury, Lynn, Mass.
Miss Laura B. Woodbury, Lynn, Mass.
Miss Louise Woodbury, Lynn, Mass.

FIRST SESSION.

WEDNESDAY MORNING, SEPTEMBER 12, 1906.

The Association met in the parlor of Hotel Champlain at 9 A. M., the President, Mr. JAMES R. MACCOLL, in the chair.

The Secretary read the call for the meeting, as follows:

INTERNATIONAL TRUST BUILDING,
BOSTON, MASS., August 20, 1906.

To the Members:

Notice is hereby given that the stated Semi-Annual Meeting of the Association will be held at Hotel Champlain, Clinton County, N. Y., on Wednesday and Thursday, September 12 and 13, 1906.

The sessions will be held in the Hotel, at 9 A. M. and 8.15 P. M., each day.

By order of the Board of Government,

Respectfully submitted,

C. J. H. WOODBURY,
Secretary.

The Association will be welcomed by Hon. JULIUS M. MAYER, Attorney-General of New York, and members will also be addressed by

TALCOTT WILLIAMS, LL. D., of Philadelphia, and Mr. HARVIE JORDAN, of Atlanta, Ga.

The full programme will not be issued until the meeting, but papers are expected on the following subjects, and advance copies of any papers which are printed in time will be sent to the members on request:

Child Labor and the Textile Factory.
Egyptian Cotton.
Handling and Marketing of Cotton by the Growers.
Practical Experiences in Electrical Driving.
Recent Progress in Textile Education in the United States.
Singeing.
Steam Boiler Insurance in Cotton Mills a Conserver of Credit.
The Curtis Vertical Turbine.
The Drawing-In of Warps by Machinery.
The Outlook for the Cotton Grower.

On Tuesday evening, the members and guests will be received informally by President MACCOLL, the Vice-Presidents and the ex-Presidents.

HOTEL CHAMPLAIN.

This hotel is situated on a wooded promontory on the western shore of Lake Champlain, and at the eastern border of the Adirondacks, in a commanding position affording a superb view of forest and water.

The building is new, commodious and convenient, being provided with post-office, (Hotel Champlain, Clinton County, N. Y.) telegraph office and long distance telephone connections.

The grounds are extensive, with lawns and terrace gardens near the house and the forest domain is traversed by seven miles of roadways and paths. There is a golf course of eighteen holes, tennis and other sports.

TRANSPORTATION.

A special train of parlor cars will leave Boston from the North Station, on Tuesday, September 11, at 9.30 A. M., and arrive at Hotel Champlain at 6.30 P. M. Lunch will be served en route at 12.30 P. M.

The train is due to arrive at Ayer Junction, Mass., at 10.30 A. M., Fitchburg, 10.55 A. M., Winchendon, Mass., 11.22 A. M., Bellows Falls, Vt., 1.15 P. M., Rutland, Vt., 3.00 P. M., and Burlington, Vt., 5.10 P. M.

At Burlington a steamer of the Champlain Transportation Company will take the party across the Lake to Bluff Point Landing, where carriages will convey the party to Hotel Champlain, arriving at 6.30 P. M. Passengers from tributary points can leave Manchester, N. H., at 8.00 A. M., Nashua Junction, N. H., at 8.33 A. M., Worcester, Mass., at 9.32 A. M., connecting with a special train at Ayer Junction, Mass.

Persons taking the special train from the above or any other tributary points will confirm the hour of leaving by consultation with local time tables as changes are liable to be made in schedules.

Friday, September 14, steamer will leave Bluff Point Landing, N. Y., at 7.10 A. M., arriving at Burlington, Vt., at 8.30 A. M., where a special train will leave for Boston, Mass., at 8.30 A. M., reaching Rutland, Vt., at 11.00 A. M., where lunch will be served at the Bardwell House. Leave Rutland, Vt., at 11.45 A. M., due at Winchendon, 3.27 P. M., Fitchburg, 4.10 P. M., Ayer Junction, Mass. at 4.35 P. M., and arriving at Boston, Mass., at 6.00 P. M.

Prices of tickets from Boston to Boston, including transportation parlor car seats, care of baggage, meals en route, and hotel accommodations, $32.00.

Those from New York City will leave the Grand Central Station in special parlor cars on Tuesday, September 11, at 1.06 P. M., connecting at Albany, N. Y., with trains from both east and west at 4.45 P. M., Troy, N. Y., at 4.00 P. M. via Albany. Arriving at Bluff Point station, 10.09 P. M., and conveyed in carriages to Hotel Champlain. Lunch and dinner may be obtained en route in the dining car.

On the return trip, passengers for New York or intermediate or tributary points will leave Bluff Point station at 12.27 P. M., Friday, September 14, in parlor cars, arrive at Troy, N. Y., at 4.55 P. M., Albany, N. Y., connecting with trains to both east and west, at 5.25 P. M., and arrive at Grand Central Station at 9.00 P. M. Lunch and dinner may be obtained en route in the dining car.

Prices of tickets, from New York to New York, including transportation, parlor car seats, care of baggage, hotel accommodations, but no meals en route, $31.00.

These complete tickets can be obtained on application to the Raymond and Whitcomb Company, 306 Washington Street, Boston, Mass.; 25 Union Square, New York City; 1005 Chestnut Street, Philadelphia, Pa. M. M. Hennessey, station agent, New York Central Railroad, Utica, N. Y.; O. E. Jenkins, University Block, Syracuse, N. Y.; C. E. Andrews, 64 North Pearl Street, Albany, N. Y., who will also

quote prices for complete round trip tickets from other points and give full information in regard to trains and connections.

Those who desire to remain longer can do so at Hotel Champlain at $5 per day, and the agent of the Raymond and Whitcomb Company accompanying the party to Hotel Champlain will, in such cases, furnish parlor car coupons and railroad tickets returning over the same route, if due notice be given to him at Hotel Champlain.

Persons attending the meeting by other than the Raymond and Whitcomb trip will be able to obtain limited return tickets at one-third the regular price provided that one hundred tickets are brought to the meeting accompanied by a Trunk Line certificate (not a receipt), to be obtained after September 8 from the station agent wherever the ticket may be bought. In order to obtain the return tickets at the reduced prices it will be necessary to give these certificates to the Secretary, accompanied by twenty-five cents, the fee of the special agent, before Thursday noon, September 13, and on Thursday afternoon the representative of the Trunk Line Association will sign the certificates, which will enable the owner to obtain non-transferable limited return tickets over the same route at one-third the regular price. The Trunk Line Association does not permit the Secretary of this Association to sign certificates after the departure of the special agent on Thursday afternoon.

It is especially urged that all members and guests attending the meeting by other than the excursion tickets mentioned above will obtain the Trunk Line Certificates because a number of those in attendance have failed to do so at former meetings, and the interests of the Association require that as many of those certificates as possible shall be used.

The rates at Hotel Champlain are $5 per day and those who attend the meeting by other than the excursion tickets should apply directly to the hotel for reservation of rooms.

Golf Announcement.

Mr. Robert Burgess, Chairman of Committee on Golf, announces that a tournament will be held to compete for the two cups presented by President MacColl, which are now held by Messrs. George A. Ayer of Easthampton, Mass. and William L. Lyall, of Passaic, N. J.

The tournament will take place each afternoon, and those playing

over the course at any other time except afternoons will be disqualified

The conditions under which the competition will be held are that each member will present a card with his official handicap signed by the secretary of his club, and cards entitling players to compete will be given by the Secretary.

The awards are for the best gross and net scores.

The souvenir badges will be given to those members who are in attendance, and the Board of Government has given instructions that duplicates shall not be given until after the adjournment, but other souvenir badges will be given to the guests of members.

Members have the privilege of taking guests, including ladies, to this meeting and if the guests are eligible to membership, it is desired that their applications shall be received in advance of the meeting.

A blank proposition for membership is enclosed for convenience in submitting the names of any who would be desirable members. Many persons have not become members, because they have not been invited. Candidates for membership will receive the same privileges as the members. Blank propositions are also inside the front cover of the Transactions, or will be sent on application.

As the evenings are likely to be cool in the mountains at this season of the year, it is suggested that warm wraps should be carried.

It is important that the Association should be promptly informed of changes of address of any members, in order that they may promptly receive their copies of Transactions.

TRANSACTIONS.

Volume eighty of the Transactions will be distributed on the date of the meeting. Please receipt for the same by the postal card which is inserted at the title page.

The SECRETARY. Mr. President, I certify that in accordance with article fifteen of the by-laws, I have mailed a copy of this call to each of the members at least ten days before this date, and that a quorum is now present in compliance thereof and ready to do any business which may legally come before this meeting.

The Secretary read the minutes of the last meeting, which on motion of Mr ARTHUR H. LOWE, were approved.

The programme of the meeting was as follows:

PROGRAMME.

First Session, Wednesday, September 12, 1906, at 9 A. M.

Call to Order.

Business.

Welcome to the Association.
Hon. JULIUS M. MAYER, Attorney-General of New York, Albany, N. Y.

Reply to Address of Welcome.
Hon. ARTHUR H. LOWE, Fitchburg, Mass.

President's Address.
JAMES R. MACCOLL, Providence, R. I.

Recent Progress in Textile Education in the United States.
CHRISTOPHER P. BROOKS, New Bedford, Mass.

A photograph of the members and guests will be taken immediately after the adjournment of the morning session.

Second Session, Wednesday, September 12, 1906, at 8.15 P. M.

Handling and Marketing of Cotton by the Growers.
HARVIE JORDAN, President Southern Cotton Association, Atlanta, Ga.

The Outlook for the Cotton Grower.
JOHN MARTIN, of the Farmer's Educational and Co-operative Union, Paris, Texas.

Egyptian Cotton.
ARTHUR A. HASERICK, Boston, Mass.

On Wednesday at 9.30 P. M., President MACCOLL, the Vice-Presidents and the ex-Presidents will give an informal reception to members and

guests in the parlors of Hotel Champlain, at which it is hoped that all members and their guests will be present, without further notice.

Third Session, Thursday, September 13, 1906, at 9 A. M.

The Curtis Vertical Turbine.
C. B. BURLEIGH, Boston, Mass.

Practical Experiences in Electrical Driving.
JOHN A. FERNLEY, New Bedford, Mass.

Drawing-In of Warps by Machinery.
EDGAR F. HATHAWAY, Boston, Mass.

Fourth Session, Thursday, September 13, 1906, at 8.15 P. M.

Ballot for election of members.

Child Labor and the Textile Factory.
TALCOTT WILLIAMS, LL.D., Philadelphia, Pa.

Singeing.
EDWIN H. MARBLE, Worcester, Mass.

Steam Boiler Insurance; a Conserver of Credit.
HUGH NELSON, 52 William St., New York City, N. Y.

THE COMMITTEE ON MEETING,

Wearing white rosettes, consisting of GEORGE P. GRANT. Jr., *Chairman;* CHARLES A. BOWEN, FREDERICK N. DILLON, JESSE P. EDDY, Jr., DAVID S. JOHNSTON, FRANK B. KENNEY, HENRY F. MANSFIELD, JOHN P. MARSTON, RICHARD H. RICE and PARDON B. SANFORD, will take charge of the details of the sessions.

The PRESIDENT. Ladies and gentlemen, we have invaded the State of New York. Its magnificent scenery, its historic associations and the well known hospitality of the people have attracted us. It is natural, however, that we should not feel quite at home until we have heard from the state government. We are much pleased to have with us the Attorney-General of the State of New York, the Hon. JULIUS M. MAYER. [Applause.]

WELCOME TO THE ASSOCIATION.

HON. JULIUS M. MAYER, Attorney-General, Albany, N. Y.

I have been asked by the Governor to say a word of welcome on his behalf and on behalf of the State. To have the opportunity of doing so is highly agreeable, for it is a source of much gratification that you have chosen this beautiful spot within the borders of our State as the scene of your gathering together and of the valuable discussions and deliberations which are to follow.

Proud of our position as a great commercial commonwealth we are glad to know that an association of this character comes among us and emphasizes by its own work the value of intelligent co-operation in the conduct of a business so necessary to the world and so advantageous to our own country. It was a forward thought which inspired the founders of the Hampden County Spinners' Association to gather together for the purposes of mutual advantage, and it was a developed thought which resulted in the incorporation of your Association for the purpose of encouraging scientific investigation and experiment as to methods of manufacturing cotton, collecting information, promoting intercourse and establishing and maintaining a library of works on textile in that city which has been so long one of the great centres of thought and progress in this country.

In the years that have passed since the original association was founded marked progress has been made. It is not necessary for me to call attention to the remarkable improvements which have resulted during the last half century but I have in mind rather some developments along lines of action which

have brought about different methods and different points of view and different practices on the part of the business man of the country.

Time was when it was supposed that only the professional man so-called required a technical education, and it has been within a comparatively recent period that we have come to realize that men engaged in important commercial pursuits, such as your own, must measure up to a high standard of technical education and efficiency. The old fashioned notion that experience alone qualified has almost passed away. Experience was too often merely another name for length of service, and the man who was in a business thirty years was frequently regarded as more experienced than the man who was in the same business but ten years, simply because the former had been engaged in the same occupation for a longer time. We have come to understand, however, that knowledge is power, and that the manufacturer and merchant who keeps abreast of those experiments and discoveries which make for better material and less waste and who is always restless for further progress is better equipped and accomplishes more useful and profitable results than he who regards scientific investigation and new suggestions as fads which must be avoided.

The ready communication which has been brought about by the telegraph, the telephone, the trolley, the good road, and the ampler facilities of traffic have resulted in a higher degree of intelligence throughout the country, so that the most modest hamlet keeps in touch with the affairs of the world. As a necessary consequence of this progress all men, and particularly manufacturers and merchants, have learned that an interchange of views is not merely beneficial but necessary. High standards of business morality are more and more sought after not only because such course is inherently right, but also because it is wise. Besides all this we have appreciated that a discovery or an invention which saves time and decreases manual labor while it may occasion temporary inconvenience, yet by process of adjustment works out for the benefit of the trade or business

as well as of the whole people. And so, gatherings like these, where earnest men come together for the purpose of giving and receiving ideas and suggestions are most valuable and their influence is far reaching. There is another feature of your Association which seems to me most attractive. No man can do his best work unless he is interested in and proud of his calling. The manufacturer who does his work in routine fashion, without ambition or pride, and who wishes that he had chosen some other career is unfortunate for his own sake and that business in which he is engaged. To feel that the daily work with which one is occupied is of a character of which one may be proud brings with it an inspiration to do better work all the time and to attain better results. The erection by your Association of a bronze memorial tablet to ELI WHITNEY at Augusta, Georgia, the placing of a bust of GEORGE DRAPER in the Textile School at Philadelphia, the awarding of an honorary medal each year for advances in cotton manufacturing and the giving of medals to pupils in the graduating classes of the great textile schools of the country and the maintenance of a scholarship for the son of a member in one of these textile schools are all practical expressions of sentiment which, by showing appreciation of things accomplished, will urge the younger generation to further and ambitious effort.

There is another value in a meeting such as this. We are a highly sensitive and restless people and our progress has come because we are restless and we are always looking for improvement and advancement in every direction. The history of the republic shows that the people may always be depended upon to decide important questions in a sober sensible way after they have had the advantage of a full discussion of these questions, yet not infrequently those appear who desire to arouse passion and prejudice and who seek to give as the explanation of individual misfortune not the lack of ability or of industry, but wrongs in our institutions. They strive to make the unsuccessful and unfortunate covetous of his neighbor, they seek to undermine the faith of the people in their system of government and

to substitute government by clamor for government by law. They are not infrequently careless of the best interests of the people by endeavoring to destroy their confidence in their courts and by assuming that their own fiat is the law and that we have wandered away from the foundation principles laid down by the fathers. They would ruthlessly attack property rights, forgetting that the development and preservation of private property is an inheritance from the days of Magna Charta which has been preserved and fortified in the constitution of the nation and of every state whose star goes to make the flag.

In such times the earnest, thoughtful producing class is the anchor which holds the rope fast. So long as we have level headed business men the demagogue will be but a passing show, creating some excitement and curiosity but leaving behind him no influence which cannot be counteracted by the conservative forces of the community. An association such as yours represents that type of conservative force which in one form or another has been the reliance of the country in times of doubt or peril. The influence which you exercise reaches far beyond yourselves and each of you to do his full duty must stand as a pillar of safety, upholding the mighty structure of free government.

Again, I welcome you here. I express appreciation for the honor that your presence has conferred upon the State, and I wish for you the highest degree of success not alone in the deliberations of this convention, but as well in the work that is yours to do in the years to come.

The PRESIDENT. It is gratifying that the most cordial relations exist between the two leading cotton manufacturing associations of this country and that they are disposed to work together for the advancement of our industry. One of the ex-presidents of this association has been honored by election to

the office of president of the American Cotton Manufacturers' Association and he has kindly agreed to address us now, especially with reference to the address of welcome of Judge MAYER. Mr. ARTHUR H. LOWE. [Applause.]

Mr. ARTHUR H. LOWE. *Mr. President, Mr. Attorney-General, ladies and gentlemen:* I have been asked to perform a very pleasant duty. It is always well to be in the thankful mood, and I think we are all at this time very thankful to his Honor for coming before us to represent this great state and the governor of the state; and we thank you, sir, for your words of welcome and your words of approbation of our work. It occurs to me that it was a very happy thought on the part of the governor to send you, sir, to welcome us here. We are glad that he sent a representative of the law instead of a representative, for instance, of the agricultural department. Our friends are more or less sports, and they are more likely to fall into the hands of the law than into the hands of the agricultural department. [Laughter.] Some of our members are automobilists. They probably make somewhere from fifteen to eighteen miles an hour [laughter] and brag about forty miles an hour. But in the courts they always claim that it was about eight or ten. If any of those should fall into the hands of the law I pray for them your indulgence. We also have here some golf cranks, each of whom thinks he can drive the longest ball, make the finest approaches and "putt-out" with the least number of strokes. I am sorry, sir, that you did not refer to the fact that we are developing that branch of the cotton industry [laughter] and that we loan to the successful member — usually the one who has the largest handicap — a cup from year to year. Since I came into this room I have heard that there are to be some horse races in this neighborhood while we are here. Now, I understand that it is against the law in some parts of this state to gamble at horse races, and if any of the members should fall into the hands of the sheriff I hope they may have you, sir, to befriend them. [Laughter.]

There are many reasons why this place was selected for our meeting. In the first place, it is one of the most beautiful

places in the world, and we have come here to get for a few days some of the pure air which blows over these mountains and lakes in place of the smoke from the bad coal that we buy for our boilers. We came here to get some of the pure water, which they tell me is very good for drinking purposes if it is properly blended. [Laughter.] We came here as well to get $32 worth from Landlord BROWN'S table. Of course, the transportation, lodging, etc., are simply the rebate which we get. [Laughter.]

It was only natural that the New England manufacturer should turn to the State of New York in selecting a place for his pleasure, for the first thing that he does in the morning when he reaches for his pink and lavender hosiery and underwear is to think of the Mohawk Valley; when he reaches for his shirt he thinks of Troy, N. Y. When he gets orders for the shipment of his goods he knows that they have to cross the great State of New York by canal and rail to the great markets of the West. When he finds himself in need of orders for his goods he goes immediately to the great metropolis, New York City, to find some customer for his product and after having made his good sale he usually has to have his little pleasure, and that is the place to have it. [Laughter.] And so we have come to New York, and we thank you and the governor through you, for your cordial welcome.

The President has referred to the fact that I represent the great association of Southern manufacturers. The interests of these two associations are identical. Business is good in the South and the one reason that this meeting today is not twice as large as it is, is because they are all so busy down there filling their back orders, trying to catch up on their non-deliveries. We appreciate, Mr. President, most heartily the cordial invitation that was extended to the association. It is only another proof of the good feeling which exists between the two.

Business is good; it is too good to be disturbed, as has been said by his Honor, by the passing shows. Even the great spectacular politician, who has probably come home to attend his own funeral, makes great speeches in New York without disturb-

ing in the least, the serenity of the business world. It takes a good deal of that sort of thing to disturb a body of men like these, and we look foward to a long period of continued prosperity.

I have played my game, Mr. President, very poorly; I have made bad drives and bad approaches, and at the moment I feel that it is better for me to "putt-out" than it is to be put out. [Applause.]

PRESIDENT'S ADDRESS.

JAMES R. MACCOLL, Providence, R. I.

Fellow-Members and Guests of the National Association of Cotton Manufacturers :

It gives me much pleasure to welcome you all to this convention which is the eighty-first of our Association and the first under our new name. The past summer has been a trying one for cotton manufacturers, on account of the almost unprecedented humidity and its effect upon many mill processes. It is to be hoped that the fine air of Lake Champlain will provide the right kind of tonic to send us home with renewed strength to grapple with the problems of the coming winter.

The change of our name to The National Association of Cotton Manufacturers is justified by the fact that twenty-five per cent. of our membership is outside of New England, and the belief that this proportion will probably be materially increased in the future. As a national association, it is fitting that we should hold our autumn meetings as often as possible outside of New England, and thus keep in closer touch with the members who reside in other States. It behooves us to take an active and aggressive interest in everything that tends to develop cotton manufacturing in our country. We desire to see the Southern states maintain their supremacy in supplying cotton for the world's use, and we should endeavor to co-operate with the growers in a loyal and friendly spirit in their efforts to obtain a fair and profitable return for their product, and to improve the methods of handling and marketing the raw material. Our aim should be to work harmoniously with other manu-

facturers' organizations, not encroaching on any fields of effort that are covered by them, but ready to do the things that are our special province or are being neglected.

Our Association brings together at its meetings a large number of practical men, and affords opportunity for the public and private discussion of technical questions, and it should be the endeavor of our Board of Government to present papers that cover the latest improvements in machinery and processes, or deal with the commercial problems affecting our industry. Recognizing that the future success of cotton manufacturing in this country in competition with the world, must depend on the training and ability of the men who manage our mills, it is the duty of this Association to encourage textile and technical schools, and the young men who are starting out in the business and who, later on, will be its leaders. While seeking primarily the advancement of cotton manufacturing in our own country, we should be ready to co-operate with foreign associations in correcting abuses and in promoting the welfare of our world-wide industry.

In furtherance of such purposes, our Association took a leading part in arranging a conference of growers and manufacturers, which was held in Washington on May 1st and 2nd. Considering all the circumstances, it is remarkable that such a gathering should not have been inaugurated many years ago. Two days of friendly discussion did much to correct misunderstandings and hasten needed improvements. It is my opinion that similar conferences should be continued at regular intervals and that they should be made as representative as possible of all cotton growing and manufacturing interests.

Much attention was given to better methods of ginning and baling, and the following resolutions were prepared by a special committee and adopted by the Conference:

1. That all bales be made of standard dimensions.

2. That light weight new burlap be used for bagging, or if conditions justify, that cotton canvas be used.

3. That ten ties be used on all bales, with the Egyptian style of buckle preferred.

4. That all cotton should be bought and sold net weights.

5. That a committee be appointed whose duty it shall be to have cotton baled as above, and to submit same for practical test to consumers. That this committee shall have power to investigate and report on the various new methods of ginning and baling generally. This committee to report at a future session of the Conference.

At present the American manufacturer pays the price of cotton for bagging and ties, and the foreign spinner, buying on the 6 c. i. f. basis, although apparently getting tare deducted, really pays for it also, as it is added to the price before being taken off. The present method prevents progress in baling cotton, because it is for the interest of the grower to use cheap and heavy covering. The above resolutions suggest the proper remedy, namely, to pay for only net cotton. It will then be advantageous to the grower to use lighter and better material, thereby making a reputation for putting up his product properly. It is a well known fact that the success of many manufacturers lies largely in the careful and artistic putting up of their goods. Thus they secure a better price than their competitors who send out their merchandise in a slovenly and unattractive condition. The same principles should apply to raw cotton. A great deal has been accomplished, if, by direct contact with growers, manufacturers can get them to see that carefully ginned and packed cotton will command a price that will more than repay them for the additional expense incurred. Who can estimate the millions of dollars that are annually thrown away by unnecessary fire losses, insurance, freight charges, waste, labor in manufacturing, and inferior cloth, as a result of the poor manipulation of the raw material before it reaches the mill? It is desirable that this committee of the Conference should energetically pursue the work assigned to it in relation to new systems of ginning and baling.

The Washington Conference adopted resolutions in favor of

the change of the cotton year to August 31st. As a result of recent scientific effort to combat the boll weevil, earlier maturing types of cotton are being planted, and the quantity of new cotton ginned and marketed in August is therefore increasing. In 1903 only 17,000 bales were ginned in August, and in 1905, 483,000 bales. Mr. HESTER of the New Orleans Cotton Exchange has, in a recent letter, approved the suggestion and expressed his willingness to publish comparative statistics for several past years, made up to the new date, thereby overcoming one objection to the change — that it would destroy comparison. Secretary WILSON of the Department of Agriculture and Superintendent KING of the New York Cotton Exchange have also favored the alteration.

At the Washington Conference the growers stated their determination to build storehouses throughout the Southern States, for the double purpose of protecting the cotton from weather damage, and of enabling them to market it more gradually during the year, directly to the spinners. This movement has received the cordial endorsement of manufacturers, and we are glad to know from recent reports, that many warehouses are being built. A letter dated August 29th, from a prominent official of the Farmers' Educational Union states that one hundred and fifty warehouses have been erected in Texas, with a large central building at Houston, capable of holding 50,000 bales.

I had the pleasure of attending in June the Third Congress of the International Federation of Cotton Spinners' and Manufacturers' Associations, which was held at Bremen. The Federation now represents about 55,000,000 spindles. There was present a large and influential gathering of delegates from all the countries of Europe which spin cotton, except Russia. The City and the Cotton Association of Bremen provided most generous hospitality, and at the close of the sessions the German Lloyd Line entertained the members and guests in one of their steamers for three days at the Kiel Regatta.

The Federation is slowly but surely gaining in solidity and

power, and will have to be reckoned with by speculators in any future attempt to unduly inflate or corner cotton. Its members earnestly believe that international combination is necessary to deal successfully with conditions that now prevail or may arise in the future, and that it is important to lay a foundation of international amity and good-will. Throughout the meetings the utmost harmony and friendship were evident.

Valuable work has been done in providing statistics of cotton stocks and consumption in Europe, which, in conjunction with similar reports from the United States Census Bureau, will help to secure stability of price and concerted action in the event of a shortage of raw material. An international commission was appointed to prepare revised rules for cotton exchanges in their dealings with spinners, and definite action in several important matters may be expected when the commission presents its report to the Federation.

A general desire was expressed that some way could be devised to insure a fair and steady price to the American growers, so that they would find it profitable to produce an ample supply for the increasing needs of the world. A carefully-thought-out paper was read by Herr LANG of Switzerland, proposing the formation of a company of spinners to buy 1,000,000 bales or more, this cotton to be held as a reserve and sold if the market advanced to a certain point. The buying and selling prices would be fixed in advance of the growing season, so that the purchase price would be a guarantee to the grower and the selling price a preventive of extreme speculation. Copies of this paper will doubtless be received later for distribution, and the subject will be found interesting.

Excessive damp in cotton, with inadequate allowance when discovered, is a grievance which European spinners complain bitterly of. It is possible that in this country we have not given sufficient attention to this, and that a large invisible loss is occurring in many mills. It seems reasonable that after careful scientific investigation a proper standard of moisture can be established, which will be fair to both grower and user. Eight

and one-half per cent. regain has been to some extent recognized as the cotton standard. Our Association could do good service by instituting a series of tests to determine the practicability of establishing this as an exact standard for buying cotton, and I would suggest that our Board of Government give attention to this matter. Those of us who are woollen manufacturers know how essential it is to watch closely the moisture in raw material and finished product.

Another subject for investigation also referred to at the Congress, is the compressed density most suitable for American cotton. The advantages of the Egyptian bale have been frequently touched upon recently, and it has been suggested that a like density of forty pounds per cubic foot would be injurious to American cotton. I should like to see tests made at various degrees of compression, to determine this point.

The New York future contract is being severely criticized at present by growers and manufacturers. It is asserted that the wide disparity between contracts and spots is injurious, and also that contract cotton cannot be bought to any extent by the spinner for actual consumption in his mill, because of the variety of tenderable grades and staples.

The whole question of the future market and its influence upon the cotton industry, is worthy of consideration by every manufacturer. The system of hedging is so much utilized that it would revolutionize the industry to abandon it, if that were possible. Many believe, however, that the evils of the system and the injury to the trade far outweigh the benefit derived from it. It should be remembered that the wool trade of the world is of equal magnitude to the cotton, and that it is carried on without future contract trading. It would be hard to find a wool manufacturer who would like to see the cotton system introduced in his business. Then, again, it is generally understood that Continental spinners seldom use the future contract market, and this may be said also of a large majority of American manufacturers. It is certainly a remarkable perversion of sound business principles, that in the New York Exchange

probably 150,000,000 bales of cotton are bought and sold annually, while the contracts that mature and are delivered, require only a few hundred thousand bales to fill them. It is apparent that only a small part of this enormous volume of sales is for hedges against sales or stock, and that the great bulk is for speculative, if not gambling purposes.

I would suggest that the International Federation and the United States Census Bureau should ascertain from spinners in their next annual September 1st report, the number of bales they have bought and sold in the future contract market. It would be interesting information, and might lead later on to legislation that would provide accurate statistics of the cotton bought and sold on future contracts in the various exchanges of the world.

The present New York future contract permits the delivery of any or all of thirty grades, including tinged and stained, the basis being Middling and the differences ranging from 1.50 cents off to 1.30 cents on. The most undesirable cotton is of course always delivered on contract, and each 100-bale contract may contain a large variety of grades, and also inferior staple. The result is shown in the present position, that New York contracts for the present month are quoted one and one-eighth cents less than spots in New York, and one-half of a cent less than spots in New Orleans. As a remedy it has been suggested to reduce the number of tenderable grades by excluding some of the lower grades that are now accepted. It is claimed, however, by many experts that a limitation of tenderable grades would render corners more easy, and that such has been the past experience in New York and Liverpool. If this be true, it is unwise to urge a change which might create a worse condition than now exists. Another plan advocated is to make the difference between grades more equitable and harmonious with market values, to adopt a minimum standard of deliverable staple, and to require that each 100-bale contract shall be uniform in grade, or vary, say, only one-half grade up or down.

It is unfortunate if New York becomes a purely speculative

centre instead of the large spot market for cotton which it might be, and it is to be hoped that the more conservative element in the Exchange will endeavor to bring about conditions more in harmony with the needs of spinners. Even from the standpoint of hedging, it is important that contracts should remain in closely uniform relation to spots, in order to be safe for the spinner to use.

The Bremen Cotton Exchange has a membership about evenly divided between spinners and merchants, and its marked growth and success are attributed to their cordial co-operation. Representatives of the spinners are on the directorate of the Liverpool Cotton Association. It would, in my opinion, be advantageous for the New York Cotton Exchange to associate in some way representative manufacturers in its counsels, and thus add to its usefulness and power.

The fiscal year ending June 30th, closes with exports of cotton manufactures amounting to $53,000,000, being an increase over the previous fiscal year, of $3,000,000. In comparison therewith, the record of great Britain's exports of cotton goods is notable, namely, $450,000,000 for the year ending December 31, 1905, an increase over the previous year of $40,000,000. If the present rate of increase is maintained during the remaining months of this year, British cotton exports will amount in 1906 to approximately $500,000,000.

The subject of foreign trade has been thoroughly discussed at our previous meetings. When production again overtakes domestic consumption, new effort will probably be put forth to increase exports. There is a boundless opportunity for American cotton manufacturers to extend their business in foreign lands. Meantime Congress has in response to petitions for a cotton commission, appropriated $50,000 for the purpose of sending cotton experts abroad (under the direction of the Department of Commerce and Labor) to secure all available informaton regarding fabrics, finishes and commercial methods.

The equalization of conditions of labor in the Northern and Southern states continues. South Carolina manufacturers have

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voluntarily adopted a sixty-four-hour schedule, to be followed in two years by a further reduction of two hours and in four years by a sixty-hour schedule. Other states will undoubtedly follow suit. The minimum age of child labor is also being raised. The day seems now much nearer when practical uniformity as to hours, wages and age limit will prevail throughout the country, and this not solely by legislation, but to a large degree by voluntary action.

The wave of tariff revision and reciprocity is subsiding. Under the present law there is marvelous prosperity, in which all classes of the people are sharing. Common sense says, "Let well enough alone." Reciprocity is found upon investigation, to mean the sacrifice of one section of the country or one industry, that another section or industry may grow more rapidly. In nine years under the present tariff the national exports have increased from $1,032,000,000 to $1,717,000,000, which places the United States in this respect in the first rank among the nations of the world. With labor and capital fully employed and unable to meet the demand, it would surely be folly to reduce duties and buy more foreign goods, in order to increase our exports by an equal amount. The chances are we should accomplish the former but not the latter.

There are no very important advances in machinery to chronicle at this time. It is little by little that progress is made. Many minds are at work in this country and abroad and continually new devices are appearing to improve quality or cheapen cost of labor. At our last meeting a paper was read on reinforced concrete construction. The cost of building is greatly increased in recent years, and it would be of advantage to the trade if any new and cheaper method could be adopted. As the principles of reinforced concrete construction become better understood and its cost reduced, the probability is that it will be extensively applied to cotton factories.

We ought to have a paper at our next meeting on recent mill construction in England where approximately one hundred new mills have lately been erected.

Electric driving of machinery continues to make rapid progress. Two papers on this subject are on our present program. The turbine engine is now attracting much attention, and an important paper will be presented on that topic.

As a result of a recent European trip a few observations of comparative conditions here and abroad may be of interest. My opinion is that the best practice in cotton mills in England and on the Continent and in the United States is practically on a par of efficiency as regards machinery and management. There are few secrets nowadays in cotton manufacturing. New devices and methods wherever originated are quickly known on both sides of the ocean and if meritorious, they are as quickly adopted by the most progressive mill men.

In all countries there are many illustrations of inefficiency and slipshod work and more than ever before, what counts in results is management, both commercial and technical.

The different systems of buying cotton are noteworthy. In Bremen there is no future contract market as in New York or Liverpool, nor is there any accumulation of spot cotton, but the system prevails of buying for future delivery, cotton of fixed grade and staple. The exchange has an organized system of arbitrating cotton on arrival, if so requested by the buyer. Last year 1,933,000 bales were imported and 1,778,000 or about 92 per cent. were so arbitrated. Not only is the market difference allowed on inferior shipments but an additional penalty is imposed. It is, therefore, so expensive for a merchant to deliver inferior cotton, that the shipments are generally up to the standard ordered. The Arkwright Club has recently issued revised rules for buying cotton. They are excellent, but we need in addition a definite statement of the methods of settlement in the event of shipments proving inferior. The Bremen penalty plan is a good one.

In Liverpool there is a future contract market similar to New York, but in addition a large stock of spot cotton is carried amounting frequently to 1,000,000 bales. The most general method of buying cotton by English spinners, is to purchase

spot cotton as needed, at points on the contract market price. Distant requirements can be hedged by buying futures, or actual cotton at points on subject to call.

There is danger of New York becoming purely a hedging and speculative market. Compared with Liverpool or Bremen, its transactions in actual cotton are unimportant.

Negotiations are now in progress in England to arrange an automatic adjustment of wages based either on the return to capital or on the margin between cost and selling price. If this can be brought about it is hoped to avoid the conflicts which have been so expensive to both capital and labor in the past.

Both abroad and here there is marked development in welfare work, indicative of better relations between employers and employees. At our Atlantic City meeting special attention was given to this subject. Every cotton manufacturer should do some work of this kind, but the form which it assumes must be dependent on the conditions and requirements existing at his mills.

In closing, permit me to express the desire and hope that the sessions of the Convention may be faithfully attended, notwithstanding the charm and beauty of the place where we meet, and that there may be ample and instructive discussion of the subjects to be dealt with.

Mr. LOUIS SIMPSON. Mr. President, I would compliment you on your very able address. I missed one mention in it, and that is your visit to the South with the party of spinners from the Old Country. At the spring meeting we were told that these gentlemen could not tell us what they were after on this side because they had to report first of all to those who had sent them. I understand that they have reported and I think that the members of the association would be glad to learn what all the fuss was about and what conclusions they have come to as a result of the visit to the South; and if you would not mind giving us the information I think the members of the Association would appreciate it.

The PRESIDENT. I shall be very glad to answer the question. When I was in Manchester a month ago they were still struggling with their report and were meeting twice a week in their endeavor to complete it. When it is ready it is to be turned over to the combination of manufacturers who sent them here. I presume later we shall have an opportunity to see the report.

Mr. ARTHUR H. LOWE. Mr. President, I would like to ask a question in reference to the International Federation. Are either of the associations in this country represented in its membership? What is the form of their organization and who make up the membership of that Federation?

The PRESIDENT. Our Association is not represented. We have simply been invited as a matter of courtesy to attend their conventions.

Mr. ARTHUR H. LOWE. What is the form of their organization? Could we not be represented in the membership?

The PRESIDENT. I doubt if it would be to the advantage of American associations to be represented in their membership, as our interests are not exactly identical with theirs. They contribute a certain amount per spindle or per loom to meet expenses. They are doing some work which it is not necessary for us to do. For example, our National Census Bureau compiles statistics which they are attending to in Europe and as American manufacturers we are not greatly interested in cotton growing in other companies.

Mr. ARTHUR H. LOWE. It seemed to me, Mr. President, that many of the things to which you referred were identical with our industry here and that we might very properly co-operate along many of the lines upon which they were working, and I wanted to inquire what their organization was or how it was made up and whether we were or could be represented in the membership.

The PRESIDENT. In the Transactions of our last meeting, which are being distributed from Boston today, there is a full account of the organization of this Federation on page 219, in the statement made by Mr. H. W. MACALISTER, chairman of the commission.

Mr. LOUIS SIMPSON. I think, Mr. President, the trouble is this, that the federation in Europe is a federation of concerns, whereas we here are simply a federation of officers. That is a great difference.

The PRESIDENT. That is quite true, sir. We are very glad indeed to co-operate with them. There are many things, as Mr. LOWE has well remarked, that we can unite upon and to that extent our relations with the International Federation are very cordial. We are glad to work with them in anything that is for the advancement of the industry, so far as it is in harmony with our ideas as American manufacturers.

The PRESIDENT. The paper which we are now to listen is on Recent Progress in Textile Education in the United States, a matter in which we are all interested. We are gratified at the great progress which has been made in this direction in the last few years and those who have studied the subject at home and abroad realize that there is a great deal more to do. The gentleman who is to present the paper is fully qualified to tell us what has been done, and what should be done in the future. I present Mr. CHRISTOPHER P. BROOKS of New Bedford, who is one of our Directors and needs no introduction.

A REVIEW OF RECENT PROGRESS IN TEXTILE EDUCATION IN THE UNITED STATES.

CHRISTOPHER P. BROOKS, New Bedford, Mass.

Seven years ago this fall I had the pleasure of addressing this Association on the subject of Textile Instruction by Mail and also at previous meetings on other branches of textile education. When the Board of Government recently requested me to again discuss this subject, I could not conceive of a better method of dealing with it than to review the progress that had been made in textile education in the United States since that date.

Seven years ago we had but three Textile Schools, the pioneer American Institution of the present textile educational system, namely, the Philadelphia Textile School, which is a part of the School of Industrial Art of the Philadelphia Museum of Philadelphia, Pa., — and the then newly established Lowell Textile School of Lowell, Mass. These represented residential textile education, while the American Correspondence School of Textiles, now the Textile Department of the International Correspondence Schools was the sole representative of correspondence textile education.

In the intervening period the Philadelphia Textile School has increased its curriculum, and the Lowell School has moved into a new building and extended its scope by the addition of instruction on several subjects of an allied nature; the Commonwealth of Massachusetts, jointly with the City of New Bedford has established the New Bedford Textile School, which was opened in October, 1899, and has since been twice enlarged; in March,

1904, the Bradford-Durfee Textile School of Fall River, Mass., was opened under the auspices of the Commonwealth and the city in which it is located. Nor have other communities been unmindful in providing facilities for the textile education of their sons, since the Georgia School of Technology has added a Textile Engineering Department which is well and favorably known in the South for its completeness and efficiency. In South Carolina textile instruction is now included in the work of the Clemson Agricultural College. The North Carolina College of Agriculture and Mechanic Arts has added a Textile Department to its educational work at West Raleigh, N. C. The Mississippi Agricultural and Mechanical College includes a well equipped Textile Department, and in Texas the possibility of a textile education has been provided for by the addition of a a department devoted to textile subjects at the already extensive Agricultural and Mechanical College at College Station, Texas.

On a smaller scale facilities are provided in some cities for teaching textile subjects on which instruction can be given without an extensive equipment; for example, the Swain Free School of New Bedford, Mass., gives instruction in textile ornament; the Rhode Island School of Design, Providence, R. I., includes textile designing as one of the studies; and at the Y. M. C. A. in Pawtucket, R. I., and also at Adams, Mass., evening students are received in classes of instruction on textile calculations. It will thus be seen that each of the larger sections of the United States where textile manufacturing is conducted, has one or more representative residential textile schools; but they only meet the popular demand in their own immediate vicinity, since they are too remote from very many extensive manufacturing cities and towns for the work people to take advantage of the evening classes. In the Southern schools evening classes are not conducted. In the Philadelphia school, the evening classes are an important feature of the school work and in the New England schools the most important.

The National Association of Cotton Manufacturers has repeatedly shown its approval of the movement in favor of textile education, as is evinced by the annual offer of medals, one to each of the larger textile schools, for the student of the graduating class who shows the greatest excellence in his studies. It is also the custodian of the trust created some years ago by Mr. WILLIAM FIRTH of Boston, Mass., providing for a free scholarship, valued at $120 per year, tenable at the New Bedford Textile School by the son of any member of the Association, the beneficiary being nominated by our Board of Government; the museums and libraries of the various textile schools contain contributions made from time to time by the Association which prove the practical interest of the Association in the textile educational movement.

In the point of the number of schools, the United States is behind the European nations, but in equipment and extent of studies our schools compare very favorably with those abroad.

Important as is the increase in the facilities for residential school education, the most striking development has been in providing facilities for, and the success that has attended the giving of, a textile education by correspondence. At its best, a residential school is local in its influence. It is true that any school of this nature is open to any person but the expense of residence in a city where a textile school exists, of tuition and other pecuniary obligations, limits the number of students. To those men, therefore, who are already engaged in the textile trade, possibly with the responsibility of families depending upon them, and who find it essential to earn a livelihood, a residential school, however desirable, does not appeal.

When I last addressed the Association seven years ago on this subject, the importance of this fact had become impressed on my mind and I had then provided facilities for giving a technical education in textile subjects by correspondence, which were already being taken advantage of by a few hundred students throughout the United States. The success that has been met with in this movement has been such that now there

are several thousand men enrolled for correspondence textile courses in the Textile Department of the International Correspondence Schools under my supervision, representing not only every textile city or town but every mill of any importance in the United States and Canada. These men have the option of selecting any one of fifteen textile courses of study, in which they are instructed by means of printed lectures prepared with the greatest care and accuracy, illustrated to a perfect degree, and in pursuing their studies they receive the assistance of competent instructors. As each lesson is studied an examination is submitted by the student and passed upon by expert examiners. Upon the satisfactory completion of this work the student is provided with a more advanced paper or one on another subject, according to the course for which he is enrolled.

The courses require the study of from 19 to 68 instruction papers, according to the selection made by the student on enrollment. Certificates of Proficiency are given at intervals throughout the course and upon its completion a Diploma is awarded. The studies are conducted by students at their homes in their spare time, generally in the evenings, or in the mills out of business hours, by special permission, or in study clubs.

The length of time required for a student to complete a course of textile instruction by correspondence depends largely on the particular course for which he is enrolled, complete courses naturally requiring a much greater length of time than do partial courses. It also depends a good deal upon the natural ability of the student, his previous education, habits of application and the time that he is able to devote to study. In exceptional cases students have completed our short courses in three months and our longer ones in a year, but in the great majority of cases a longer time is required. The student, however, does not have to complete his course before beginning to derive benefits from it, since every instruction paper that he masters fits him for some particular branch of the work which he is qualifying himself to perform. Many students have been

qualified for advancements or for positions in other lines of work before they had finished even a third of their course.

The combination of this acquisition of a theoretical education with its practical application in the mill during the day has proved to be the most satisfactory method of giving a textile education. A student progresses rapidly or slowly as he wishes and completes his course of instruction at his own convenience without any extra payment beyond the first amount agreed upon. This amount is a fixed and moderate sum, payable either as a cash payment or in instalments and covers all expense necessary.

In addition to the printed lectures or instruction papers provided, the schools have prepared a library of textile information at an expense of between $60,000 and $70,000, which is supplied to a student for reference at the commencement of his course of instruction without extra charge, and which may be described, without fear of contradiction, as the most complete encyclopedia of textile information ever published.

The textile industry of America must have already greatly profited by the acquisition of knowledge by these students. Correspondence education can be obtained wherever the mails reach, and consequently the establishment of the Textile Department of the International Correspondence Schools has been equivalent to placing a textile school in every mill center, without any cost to the community. There is not a mill town in the country which is not represented in the student body of this institution, and probably not a single mill of any size but what has one or more students; many of the larger mills have from twenty to thirty students, and in some of the larger mill cities the number of textile correspondence students reaches into the hundreds. The resident textile school does not have a sphere of efficiency anywhere near approaching this in magnitude, being more local in its influence and unable in many cases to reach those who need textile education the most. The system of correspondence textile education also benefits a large number of men who, even if they were able to attend a

textile school, could not avail themselves of this privilege because of a lack of early training. Most residential textile schools require for admission either a diploma equivalent to a High School diploma, or the student must pass an examination covering a similar amount of ground. The correspondence system assumes that the prospective student knows nothing whatsoever beyond the ability to read and write English. If he so wishes, his instruction starts from the beginning with the very simplest subjects of elementary arithmetic and gradually proceeds to the more advanced and technical subjects in which he is vitally interested. In giving these men a better knowledge of the construction of machinery, its adjustment and changing, in obtaining desired results in designing fabrics, and in the one hundred and one problems that arise every day in the mills, there has been placed at the disposal of the manufacturers a large body of men better qualified to fill responsible positions and to place in charge of departments of the mill.

Although the student body is composed of a great many young men, still many are more mature and experienced; there are many men in responsible positions, such as treasurers, superintendents and designers, who have enrolled for courses of instruction, such men placing a high value on the valuable reference library.

Perhaps one of the strongest proofs of the esteem in which this institution is held by practical and thinking men is the fact that no less than fifty-eight members of this Association are now, or have been, enrolled as correspondence students in the Textile Department of the International Correspondence Schools. So important a factor has correspondence textile education become in the United States that it is hardly possible at the present time to examine a trade paper that makes the textile industry its speciality without noticing in the personal columns names of men who are, or who have been, students. Such items in the trade papers often note the advancement of these men to responsible positions.

Nor is the scope of the institution limited to the United

States. There are many students in Canada, Mexico, and even in England, Germany, Austria, France, Italy, Spain, Japan and China, taking textile instruction from New Bedford. Neither is the benefit of correspondence education limited merely to subjects that are purely textile in their nature. This is only one branch of the work of the huge International Correspondence Schools established in Scranton, Pa., in 1891, by Mr. THOMAS J. FOSTER, still the president of the schools, which have an enrollment of nearly a million students, teaching 250 commercial, scientific, or industrial courses and employing 2,650 people.

One of the recent publications of this institution is a book containing the names and addresses of 75,500 students who up to a certain date about one year ago had either graduated or made such advancement in their studies as to qualify them for higher positions or increased salaries. The files of the textile department are full of testimonials from students who have derived great benefit from their courses, and there are hundreds of cases of advancement to higher positions.

Prominent among these are cases of advancement from card hands to overseers of carding; from loom fixers to overseers of weaving; from overseers and second-hands to the position of superintendent. One case that I recall is that of a shipping clerk who enrolled with us in 1899, who is now treasurer of the mill in which he was thus engaged at that time.

Another is that of a student who enrolled with us in 1900 and was then getting fifty cents a day as a card hand, who is now superintendent of a mill at $2,400 a year with the promise of an advance at an early date to $3,000.

The owner of several large cotton mills in Spain, a member of the Spanish Parliament, originally trained as a banker but owing to the unexpected deaths of members of his family became proprietor of, and had to take charge of, these textile establishments. Having a good knowledge of English he enrolled as a student and after making considerable progress with his studies wrote me that his course had saved thousands of dollars in many ways to his concern, especially in the more intelligent buying of machinery, and enabled him to supervise

the work of the mills as he otherwise never would have been able to do.

A member of a firm building perhaps the largest amount of cotton machinery in the United States writes that he considers our system of instruction of great interest and value and that he constantly refers to our publications for his own information.

The manager of one of the largest embroidery works in France has gained such a knowledge of cotton machinery as to enable him to fit up and regulate cotton machinery with which he was previously absolutely unacquainted. These instances are simply selected at random from hundreds of similar cases. Advances of salary from 50 to 350 per cent. since the enrollment of students are not unusual.

Many interesting letters are received from students and many students, especially those who are enrolled in designing courses, send the schools samples of their work. Some of the fabrics submitted are excellent in design and coloring and bear evidence of the value of the technical instruction that the student has obtained in his course. One case in particular comes to my mind of a student who was just entering upon the work of designing cotton fabrics and by adopting the principles laid down in his instruction papers succeeded in producing an excellent line of samples. Many of these fabrics were quite complicated in structure, involving the use of extra, or figuring, warps, etc. In this case the samples were made on a dobby loom, although the student had never previously seen one at work and derived his information entirely from correspondence instruction.

Aside from the actual information that is imparted to the student in a course of textile instruction by correspondence, a large amount of benefit accrues through the habits of study created and the increased enthusiasm and interest that the student has in his work.

The influence of a correspondence education is also felt in the up-building of the character of a student. To undertake a regular course of study evening after evening, following upon a hard day's work in the mill, requires a development of deter-

mination and persistence, and the sacrifice of pleasure and habits that would bring no advancement. It develops a systematic method of approaching problems, and gives a mental training in system and routine that has a life-long effect. It probes a man's scope of knowledge of his own and allied trades. Without such instruction many a man would be limited to a knowledge of the department in which he works, but on the completion of a course of correspondence instruction, he has a knowledge of all the departments, and even of other branches of textile industry, which although in some cases he may never put into practice, must cause him to take a greater interest in the work of his own department, and be able to anticipate or trace many technical matters that would be otherwise impossible.

An important point for consideration is that this education is being given without any expense to the communities that are deriving the benefit from it. During the last ten years we have had over 1500 correspondence textile students in Massachusetts alone. These men like all other correspondence students have appreciated their education sufficently to be willing to pay for it at a price that approximately covers the cost, and many of them have stated that the education they have obtained is worth many times the money it cost to them. During the same period the Commonwealth of Massachusetts and the cities of Lowell, New Bedford and Fall River have appropriated at least half a million dollars for textile education alone, and it is doubtful whether the number of individual students passing through these schools and studying exclusively textile subjects equals the number who have enrolled for correspondence textile courses from Massachusetts alone, and whose technical education has not cost the Commonwealth one dollar. One feature of correspondence textile education that is of practical interest to manufacturers is a system maintained for placing mills desiring skilled help in communication with worthy students who have graduated or made marked progress in their studies. This service is free both to the mill and to the student and many manufacturers have availed themselves of this opportunity of obtaining skilled

men who not only have a theoretical, but also a practical training in the mill business.

These facts are merely mentioned to show that the International Correspondence schools have conducted welfare work which greatly benefits the textile workers of this country and which has already received the hearty co-operation and appreciation of many textile manufacturers; and it is hoped that the presentation of these statements may result in still further evidences of approval and co-operation of the members of this Association.

In preparing the material for this paper there has been a reminder that textile education in the United States possesses a greater dignity of age than is usually recognized. For the unearthing of records of its early development credit is due greatly, if not wholly, to our Secretary, Mr. C. J. H. WOODBURY, whose researches in the industrial history of Massachusetts are extensive and thorough. In an address that he made in 1897 and from which I now quote freely, he drew attention to the fact that on September 8th, 1636, the general court of Massachusetts "Voted: 500 pounds to found a college," and two years later this grant was augmented by the bequest of Rev. JOHN HARVARD, who gave to it his library, half of his property, and which took upon itself his name. The amount granted was equal to the whole colony tax for the year, and EDWARD EVERETT stated that this is the first instance in history where the people voted public funds for education.

But these forefathers meaning to build wisely in attending to the needs of the people, ordered the magistrates and deputies of the several towns in May, 1640, less than twenty years after the landing of the Pilgrim Fathers and Mothers, to make known the "absolute necessity" which existed for the manufacture of linen. They were to ascertain the amount of seed in each of their towns, the names of the persons skilled in breaking, spinning and weaving hemp and flax, and to recommend what steps should be taken to instruct the young in spinning yarn and weaving cotton wool. It appears that this was probably the

earliest of the industrial statistics which now serve such an important part in the world's knowledge of itself.

At the October session of the same year, a bounty of three pence on every shilling's worth of linen, cotton, or woolen cloth was voted, but this act was repealed in June, 1641, when the deputies were ordered to direct the people to gather wild hemp and to direct that all possible measures should be taken in families to spin as much as possible. They foresaw that a more systematic course was necessary, and June 14, 1642 passed the act for public education in "training up children in learning and labor," which provided for textile education, and was undoubtedly the first law for technical instruction, giving a manual training outside of the lines of book learning hitherto classed as the whole of instruction.

Citing portions of the law applying to textile instruction.

"This Court do hereupon order and decree, that in every towne, the chosen men appointed for managing the prudenciall affaires of the same, shall henceforth stand charged with the care of the redresse of this evill (*i. e.* neglect in training up children in learning and labor).

"They are to take care that such (children) as are set to keep cattle bee set to some other impliment (employment) withall, as spinning upon the rock (the rock was a hand distaff), knitting, weveing, tape, etc. They are also to provide that a sufficient quantity of materialls, as hempe, flaxe, etc., may bee raised in their severall townes, and tooles and impliments provided for working out the same: and for their assistance in this so needful and beneficiall impliment, if they meet with any difficulty, or opposition which they cannot well master by their owne power, they may have recourse to some of the magistrates, who shall take such course for their help and incuragement as the occasion shall require according to justice."

These pioneers were more given to making history than to writing it, and it is but natural that we should fail to find any records indicating why this act failed to serve its purpose, but that such was the case is evident from the following act on "spinning," passed in 1655, setting forth in detail the means for instruction in spinning:

"This Court, taking into serious Consideration the present streights and necessities of the Country, in respect of Cloathing, which is not like to be so plentifully supplied from forreign parts as in times past and not knowing any better way or means conduceable to our subsistance, than the improving of as many hands as may be in Spinning Wool, Cotton, Flax, etc., doth therefore order, and be it ordered by the Authority of this Court: that all hands not necessarily imployed on other occasions as Women, Girls and Boyes, shall and hereby are enjoyned to Spin according to their skill and ability: and that Select Men in every Towne do consider the condition and capacity of every family, and accordingly do assess them at one or more Spinners.

"And because several Families are necessarily imployed the greatest part of their time in other business, yet if opportunities were attended, some time might be spared, at least by some of them for this work:

"The said Select Men shall therefore Assess such Families at half and quarter Spinners, according to their capacities.

"And everyone thus aforesaid, for a whole Spinner, shall for time to come, Spin every Year for thirty Weeks, three pound a Week of Linnen, Cotton or Woollen, and so proportionably for half and quarter Spinners under the penalty of twelve pence a pound short.

"And the Select Men shall take special care for the Execution of the order which may easily be affected by dividing their several Townes into ten, six or five, &c., to appoint one of the ten, six or five, &c., to take an account of their Divisions and to certifie the Select Men, if any be defective in what they are Assessed who shall improve the penalties imposed on such as are negligent for the encouragement of those that are diligent in this work."

These acts of the General Court indicate that the government was keenly sensible of the importance of maintaining a knowledge of the textile art. The action of town meetings and the records of selectmen's meetings indicate that this legislation was enforced.

I trust that seven years from now should it be my privilege or that of someone else to address this Association on this subject, the same ratio of progress in textile education may have to be recorded. My personal opinion is that the opportunities of the last few years in providing for the young men of this country facilities for obtaining a textile technical education have

developed with remarkable success and that the opportunities that are now open to them are wide and far reaching.

Mr. GEORGE OTIS DRAPER. I only wish to say in reference to Mr. BROOKS' paper that I think the value of this correspondence method of instruction is being very well appreciated in a great many centers. In our own works we have many men taking correspondence courses. In fact, the head of one of our departments has had, I think, four diplomas in four different courses and I think that one of our own directors is taking a course at present in this same school. We have a great many young men in different departments, largely in our drafting department, who are taking these courses, and from what I have learned myself and from what I know of the course I think it is very wise for men who are at work in actual production to thus qualify themselves further. Students who take a correspondence course and pay for it usually out of their own earnings take a different sort of interest in the education they are acquiring than many of our young men in college who are thinking very little of the information they are getting and a great deal more of the pleasures which associate with it.

Mr. EDWIN H. MARBLE. I would like to ask a question, whether one of the strongest points in favor of the correspondence school system of education has not been shown in the interest which the builders of the different lines of machinery have manifested in giving information and as far as in their power, not merely regarding the machines which they built but the working of the same. In looking over one of the books a short time ago I was surprised to see how fully and clearly certain information was set out which could not otherwise be obtained. The builders of machines have shown their appreciation of the system by contributing from their treasures to assist in the work. I have known some twelve or fifteen men in the

schools, not alone the International but other correspondence schools, and have followed their work very carefully. This is not exactly the place to criticise, but still I fear that in some cases the papers that have been returned have not been examined by parties who are thoroughly familiar with the subject themselves. For instance, the examiners sometimes criticise the use of terms which are not found in the ordinary dictionary but which are familiar to any cotton manufacturer. It seems to me of the greatest importance that the examiners of the papers should be themselves thoroughly familiar with the subject. I was surprised the other day to see a paper which had been returned in which the word "jenny" was used, a word which as applied to cotton machinery any cotton mill man would proably understand but still the examiner crossed it out and said there was no such machine built.

Mr. WILLIAM D. HARTSHORNE. Mr. President, I have been very much interested in this paper and I think it affords a partial solution for a question which has been disturbing me for a long time, and that is how we are to secure in our mills thoroughly competent overseers and second hands whose time must be devoted in their younger years to some special portion of the work rather than to any broad view of the work which they may eventually take care of. I am often asked to take a young man into the mill and allow him to go from department to department in order that he may acquire a sort of universal idea of the industry. I have always felt as though this was not a part of the manufacturing business and in fact it has been our policy to avoid it as much as possible. But it seems to me that if a young man wishes to acquire a thorough knowledge of manufacturing a good plan might be to take such opportunity as might be cheerfully granted of taking up one particular employment or entering one particular department of a mill and making himself thoroughly familiar with that, while at the same time taking such a correspondence course of instruction as has been spoken of today. That would seem to me to avoid

the difficulty of converting our mills into schools, which they are properly not intended to be. I am very much interested in the library to which Mr. BROOKS has called attention, and I should think it would be an excellent thing if it could be in the offices of all our mills with opportunity for anybody to see it.

Mr. GEORGE A. AYER. I was connected with the Textile School of New Bedford for many years. It was not uncommon to see, in classes in design and analysis, superintendents and treasurers studying a piece of cloth under the eye of a competent designer. This is typical of the feeling towards the school in that city. I admit freely and even invite, the representatives of the correspondence schools to visit the mills, and I always value a list of the men who are studying. Raw material for the coming overseers and superintendents is scarce and growing more so, and such young men are well worth encouraging.

Mr. CHRISTOPHER P. BROOKS. In regard to the remarks of Mr. MARBLE as to the drawings and information contained in the bound volumes, I perhaps ought to explain that this edition which I have brought for your inspection is new and in fact about the first set in that line turned out. For some years we used another edition. In reply to the remarks about the supplying of information and drawings I will say that in the preparation of this new edition we made a rule not to mention machines by maker's names and not to show any partiality in the selection of any make of machine that we chose for description, but in all cases, so far as we could, we selected the best. I neglected to say, and take this opportunity to acknowledge that the manufacturers have rendered every assistance whether we used their machines or not. There have been very few cases, if any, where there has been a refusal to supply the drawings or details, and in only a very few instances any pressure brought to bear to have us admit any other machine and describe that. But the drawings have not all been obtained, in fact only a small portion of them, from that source. Almost all of them have been obtained by sending our draftsmen into the mills having

the machines and, having the permission of the agent or superintendent of the mill as well as of the builder of the machinery, we have made drawings, from the actual machines themselves, while most of the text has been written by me personally. My principal duty has been the writing of the original textbooks and instruction papers and I am perhaps not as closely in touch with the correction of the examination papers as I would like to be. But I have only twenty-four hours a day, the same as anybody else, and I cannot oversee all the examination papers. Still I always endeavor to hire the best men I can get and we always invite students, when they have any question about the accuracy of any correction, to write to me personally and I am always glad to straighten it out. Our institution employs over 2,000 people and it is not possible for anybody to look after all the details personally, and on the whole there are very few complaints. I do not know as there are more than one a month in my department. I want to thank Mr. AYER very kindly for his remarks and the offer he has made, and also Mr. DRAPER and Mr. HARTSHORNE for their commendations. I do not think there is any one concern in the country where we have had more hard working students or more diligent students than from the Draper Machine Shop. There are concerns where we have more students, but none, I think, where the students have been more conscientious or worthy. If there are any other questions I shall be very glad to answer them and also be very pleased indeed to have these books inspected. I feel a little natural pride in the result of something like eight years' work on my part.

EMPLOYMENT BUREAUS.

Mr. LOUIS SIMPSON. Mr. President, I would crave your indulgence. At the meeting in Boston in the spring I gave a note to your Secretary asking the opportunity of addressing the Association on a matter of importance to the Association. Through some contretemps, the note was mislaid and I did not have that opportunity of presenting the matter. I have come

down from Canada to attend this meeting at great inconvenience for the purpose of saying a few words now with your permission. I did not offer to write a paper upon this matter because my movements were so uncertain and my engagements were so urgent just now that I was not sure of being able to attend. I have to leave this evening, so this is the only opportunity I shall have of speaking. I want to say, with your permission — Have I your permission?

The PRESIDENT. If there are no further remarks on the subject of the last paper we shall be glad to hear from Mr. SIMPSON.

Mr. LOUIS SIMPSON. Mr. President, I desire to say a few words to the members of the Association on a question of sheep stealing. It was said today to the attorney general that it was a good thing that we had the foremost law officer of the state here, for some of our members might get into trouble. The question which I bring before you I do not think would affect the members that way, but it is for the protection of ourselves as an Association that I desire to place before you certain facts which have come within my knowledge during the past few months. We in Canada are very well placed in reference to this matter, because if any sheep stealing goes on amongst those whom we employ and they are taken down to the United States, by the laws of the States those who bring such employees into the States under contract are liable to be fined and those so hired deported. But it is not in reference to that aspect of the matter that I wanted to speak to you. As far as I am concerned and the concern for which I am responsible, it is our intention in all such cases to use the laws of the States to the fullest limit. But it is to special cases which occur in the States that I refer. I am referring to the practice of certain of the textile papers inducing the employees of one mill to leave their employment and take employment with other mills. Mr. President, there are in the States certain textile papers which are managed most admirably. They are doing a noble work in the

interest of education, and it has always been my pleasure and I am sure it has been the pleasure of every member of the Association to give them all the assistance possible. Their representatives have visited the works for which I was responsible, I have introduced them to the different foremen; I have treated them as one of ourselves. Of those papers I have not one word to say. But there are publishers, and I have evidence of the fact, who work to make a big profit out of the employment bureau in connection with their paper and who ignore entirely the interest of the employers of labor and even go so far as to break the laws of the States in order that they may make money.

I can give you an instance. A man in my employ brought me a letter from the employment bureau of a paper published in Boston, telling him that if he were to apply to a certain mill in Lowell he would probably be employed at a high rate of wages. I said to the man, "Did you ever apply for this position? Do you know the people?" "No," he said, "I don't know the people; I never sent them my name; I have no desire to leave." I had reason to believe that that man's name along with the names of others had been given to the man responsible for this employment bureau by a discharged officer of the concern. I placed the matter before the American consul and I have reason to believe that the proprietor of that journal had a bad quarter of an hour. Since then I have learned that this is going on constantly amongst the mills, and it works in this way. You may have a staff of employees who are quite satisfied and content, but if you discharge a foreman or a superintendent, and he is so mean as to desire to do you harm, he is able to go to such an employment bureau with a list of your principal employees with the remuneration paid them, and the bureau can then send letters to your different overlookers, insinuating that you are not paying them sufficient and that they can get higher remuneration elsewhere, and that by applying to so and so or so and so he will probably get a place, thereby creating dissatisfaction and unrest. It is using the United States mails for an illegal purpose, and I feel sure that you must

agree with me in saying that under present conditions, when labor is so scarce everywhere, it is very detrimental and it creates disturbance in every mill where it is done. I will be glad to place in the hands of the Treasurer or Secretary the documents which I possess, and I think that we as an Association ought to try and see whether we cannot think out some method by which this kind of work may be put a stop to. I am quite sure that methods can be arrived at by which such papers as go out of their way to create all this trouble can be put out of business. I have felt so strongly upon this matter that I thought it was of interest to the members that I should come down today and explain to you what I have found out in regard to this matter. Mr. President, anything that I can do I will be very glad to do for the benefit of the Association.

Mr. JOHN A. FERNLEY. Mr. President, I am not personally acquainted with the gentleman, so that whatever remarks I make cannot be taken to be personal, but I infer that Mr. SIMPSON has been, like the most of us, somewhat down the ladder. Now if such a system as he seems to advocate had been in force in his younger days, I presume he would have staid there until the present time. I do not think, gentlemen, that any of us who have risen to our present positions would advocate or feel that we should decide to inaugurate a system that would be something on the system of baseball contracts which would prevent a man who worked for us from going somewhere else where his ability would be more fully recognized and more amply compensated. I think, gentlemen, that wherever ability is it should be compensated accordingly, and if any mill fails to sufficiently compensate a man for the labor in which he is engaged, and if any other mill or manufacturing concern can see ability in that man to warrant offering him higher compensation because of the greater value he would be to them, I think certainly the man himself demands that there shall be free access, whether it is through an employment bureau or otherwise, for that man to be enabled to obtain the recompense for his ability. I do not

know the circumstances of Mr. SIMPSON, but certainly I do not think the Association at the present time, anyway, feels that the course which he suggests should be taken up. If Mr. SIMPSON would write a paper and bring it before the Association, then we could take the matter up.

The SECRETARY. I desire to explain why this matter failed to be brought up at the last meeting. Mr. SIMPSON gave me notice, as he states, and I made a memorandum of it, but two things intervened. One was, that when there was opportunity for the matter to be taken up Mr. SIMPSON was not in the room and secondly, that the memorandum had disappeared from the Secretary's desk.

Mr. LOUIS SIMPSON. Might I reply to the gentlemen who spoke a moment ago, Mr. President? I have not the pleasure of knowing him, but I may say that he has entirely misunderstood my remarks. I have no objection to anybody bettering himself, not the least. If I cannot employ a man and make it worth while for him to stay by me he is welcome to go anywhere he likes so long as he does not leave me improperly. What I objected to was this, that an employment bureau should be given the opportunity and should take advantage of it to tamper with my people. It is permissible for any employee who wants to go elsewhere, he has a perfect right to go and have his name put down in an employment bureau. But it is quite another thing for people who have been in your employment and have left you, for bad motives to give a list of your most valuable employees to an employment bureau and the employment bureau not for the benefit of these people at all, but in order that they make a commission, to go around and seek to disturb the working staff of a concern by making its members discontented. That is what I object to. I do not object to the man leaving, but I object to these people, the employment bureau, making money in this way. I think as a legal question my point is well taken; they have no right to do it; they have no right to use the United States mail for such a purpose. As

to the man seeking to better himself that is all right. If they can find a better job and do not want to work for me, let them go, and the sooner they go the better, because I want the whole hearted working man, not the half-hearted worker. I was pointing this out for your own interests, because I can see the great damage that might occur to a concern in these days by having the spirit of discontent enter into the place, fostered by people who are making money out of it.

The PRESIDENT. Are there any other remarks? If not, the names of the Committee on Resolutions will be read by the Secretary.

The SECRETARY. The President appoints the following members as a Committee on Resolutions: WILLIAM D. HARTSHORNE, chairman; J. R. MONTGOMERY, R. M. MILLER, Jr., H. F. MANSFIELD, and ROBERT BEATTY.

SECOND SESSION.

WEDNESDAY EVENING, SEPTEMBER 12, 1906.

The Association met at 8.15 P. M., President MACCOLL in the chair.

The PRESIDENT. We much regret the absence of Mr. HARVIE JORDAN, President of the Southern Cotton Association, who expected to be present this evening but has sent a telegram that he is unavoidably detained. His address on Handling and Marketing of Cotton by the Growers, has been sent to us and Mr. GEORGE OTIS DRAPER has kindly consented to read it.

HANDLING AND MARKETING OF COTTON BY THE GROWERS.

HARVIE JORDAN, President Southern Cotton Association, Atlanta, Ga.

Mr. President and Gentlemen :—I beg to express to you my high appreciation of the honor which you have conferred upon me personally and the great Association of farmers and business men generally of the South whom I have the high honor of officially representing, for the cordial and voluntary invitation you have extended me to be present and deliver an address before your distinguished body on this occasion. The time has come in the evolution of cotton production and cotton manufacture when the growers of our great American staple and its spinners and manufacturers should be brought into closer touch and business relationship. The growers and spinners of American cotton have too long been strangers. The intercourse between these two vital factors in the cotton industry of the world has been too long left in the hands of middlemen whose interests have been guided more from a personal selfish standpoint than for the upbuilding and betterment of the industry from the broad standpoint of industrial development.

The old adage, "Let well enough alone" applies only in cases where conditions cannot be bettered. We have reached that stage of our industry now where the law of economics must play an important part in the future of cotton production and manufacture. There are many matters of vital importance which mutually affect both the growers and spinners, and in the proper solution of these problems it is the part of wisdom and sound business policy that those two chief interests in the cotton

industry of the world should cultivate a closer business relation and more friendly intercourse for the future.

It is particularly gratifying to know that the former chasm which so long separated and kept apart the growers and spinners was first bridged last May in the City of Washington, at the nation's capital, when a two days' convention was held between representative cotton growers of the South and representatives of the New England, Southern and European manufacturers. This convention was the first of the kind ever held in the history of cotton production. It was made notable because of the unusual harmony and good fellowship which prevailed from the opening to the close of the convention, and the intense interest manifested during the deliberations and discussions of all matters that were presented for discussion. It is gratifying to know that the first effort ever made to secure a friendly and business intercourse with our spinners originated with the organization of the Southern Cotton Association at New Orleans, La., January 25th, 1905, when resolutions to that effect were introduced and unanimously passed by that notable convention of farmers and Southern business men. It is yet more gratifying to know that your distinguished and highly representative Association of the New England spinners and manufacturers was the first to take the initiative and to invite a conference for a specific date, and in which commendable effort you were most cordially assisted by the American Cotton Manufacturers' Association of the South. The action of our American spinners, and that splendid representative body of Manchester spinners who were present at the Washington conference last May, was conclusive evidence of the earnest and sincere desire on their part to cultivate a closer business relation with the growers and to aid them as far as possible in the solution of many problems that are at the present time detrimental to the cotton industry.

SOME MATTERS OF MUTUAL CONCERN.

For a long time the growers were lead to believe that the spinners had no concern or special interest in their welfare so

long as they produced a plentiful supply of the staple and sold it at low prices. It cannot be denied that in some quarters this charge was largely true, especially on the other side of the Atlantic. Foreign spinners, especially those of Great Britain, have partly explained their desire for cheap cotton as based upon the fact that their customers for the finished goods are largely among the millions of the poor populations of India and China. Foreign spinners, therefore, are particularly interested in urging the growers of American cotton to the introduction of more intensive and economic methods of culture, to the end that a larger yield of the staple may be produced per acre at less cost to the grower so that profitable yet lower prices may exist. Mr. MACALISTER, of Manchester, particularly urged this point at the Washington conference last May, and while there is good, sound business reasoning in the proposition, and while considerable progress along that line is being made by the growers, yet the ever increasing cost of supplies, labor, taxable values of land and the social demands of a broader and higher type of civilization, make it extremely doubtful if cotton in the future can ever be profitably produced in sufficient quantities to meet the world's ever-increasing demands at prices less than ten to twelve cents per pound.

But aside from this one feature which may always constitute a ground for contention between the seller and the buyer, there are many other matters of paramount concern and of mutual interest to both the growers and spinners of American cotton. Among these matters of mutual interest may be safely recited the following:— Ginning, baling, covering or tare, country damage, damp in cotton, warehousage, marketing, speculation in futures and stable prices. The same circular saw which mutilated and tore the fibre in WHITNEY'S early invention is still in use today. The same old unsightly, cumbersome bale, with the same partial covering of jute bagging and iron ties that were in use prior to 1860 is persistently adhered to even in the progressive era of the twentieth century. Our cotton today is more carelessly handled on the farms than it was thirty years

ago when labor was more plentiful and farmers took more pride in sending their staple to market in first class condition. With some degree of mortification and regret I am forced to admit that farmers as a general rule show less consideration to the care of this valuable staple after it has been placed in marketable condition than any other product produced on their farms. This unpardonable neglect is due largely to the fact that the growers have not been impressed with the importance of handling this product more carefully until within quite recent years, or that better handling would net to them any better prices than cotton indifferently handled. In this connection, if the spinners would encourage the payment of an increased price to those growers who could be induced to place their staple upon the market in better spinnable condition, it would go a long ways towards bringing about quick reforms in this particular, but as a general rule the buyers of our cotton at interior points make a general deduction of so many points to cover probable losses that may accrue to them in the purchase of cotton badly handled and the grower who offers first class cotton has to suffer proportionately with his neighbors who may offer similar grades which have been subjected to country damage or inferior handling. It would be the part of wisdom and act as a superior inducement to offer a premium on all grades which are placed upon the markets in first class condition and the man who takes a pride in handling the cotton from his farm to the market should not be made to suffer in an arbitrary average reduction in prices simply because other growers are careless and indifferent. I am informed by leading cotton buyers that on country damage alone an average reduction of twelve points, or one-eighth of a cent per pound is deducted and applied to the purchase of all cotton alike. The same arbitrary rule is applied to probable future loss in the weight of cotton by interior buyers. Under this rule an average reduction of five pounds on every bale is made in the prices offered the growers and applies with equal force to the bale that is sound and dry as well as to the bale which may have been carelessly stored and shows an

excess of moisture. As these arbitrary reductions are deducted from prices offered, the average grower is ignorant of their existence. But you can readily see from instances of this kind that our buyers do not offer any superior inducement to the grower on the average bale of marketable cotton. The cotton buying world says to the growers in the fall, "Gather your cotton rapidly, even before the bolls are fully opened, gin it as fast as picked on machinery geared to the highest speed, and then rush it to market and receive the same uniform price on all grades with an average penalty for probable future reclamations charged against each alike." This is the system employed in the interior cotton trade of the South today. It has existed for years with but little improvement and the active co-operation of the spinners and manufacturers should be given to a speedy abatement of this evil.

GINNING AND BALING.

The first efforts toward decided reforms in the future handling and marketing of the South's great staple crop should be directed toward an improvement of the present system of ginning and baling. Our cotton should be ginned on roller gins which will separate the lint from the seed without cutting or napping the staple, something after the plan of the recently improved Fuller gin. From the gin the staple should be compressed in a high class power press and packed at sufficient density to enable its shipment direct to the consumers without recompression enroute as at present. The heavy cost of re-handling, the excessive freight rates, prohibitive insurance rates, difficulty in handling and the ease of damage from a number and variety of causes, make the present large loose bale of cotton as prepared at our gins a very costly item of unnecessary expense to both the growers and the spinners. If the spinners and manufacturers of American cotton are sincere in their expressed wishes to aid the growers and at the same time hold down the price of cotton to as reasonable figures as would be just and equitable to the growers, they should be prompt in assisting us

to get rid of so many of the present unnecessary heavy items of expense which are put upon the staple from the time it leaves the gin house until it reaches the spinner's factory.

One great trouble in bringing about speedy reforms in ginning and baling is due to the fact that the present system of gins and compresses is under the control of modernized trust corporations. The present gin combine in the South would suffer if the demand for saw gins ceased and the roller process were supplied from other sources. There are $20,000,000.00 invested in large compresses which would cease to be valuable if the compression of cotton was done at local gins. These large monied interests are now and have been for years fighting any improvement in the methods of ginning or baling that would jeopardize their interests, and yet the burdens annually imposed upon both the growers and spinners by their continued existence amount to millions of unnecessary loss each year. Let us combine our interests for the express purpose of forcing needed reforms along this line and with the change to ginning a staple that commands more value and the compression of a neat, uniform package that will reduce to a minimum the cost of handling, storage, insurance and transportation, the farmers will become aroused to a higher appreciation of the true value of their staple as a marketable product and take a greater degree of pride in delivering it to the spinner in first class spinnable condition.

TARE ON COTTON.

From an economic standpoint, both to the producer and the spinners, it is desirable to reduce to a uniform and minimum weight the covering of cotton. While the cost of bagging and ties falls entirely upon the pockets of the growers under our present system of marketing, yet its weight enters into the question of freight as an item of expense in the cost of delivery which deserves the attention of the consumers. The matter of tare at the present time is very unjust to the growers. The American manufacturers have agreed to take their cotton upon

an average reduction of twenty-two pounds to the bale, while an allowance of six per cent. is deducted from the gross weight of all cotton which goes to export. As the average weight of our cotton is a little over five hundred pounds per bale gross, it is evident that a deduction of at least thirty pounds per bale is made by the buyers on all cotton for export. This deduction is figured from the price offered to the farmers, as all prices in the interior are based on gross weights, and the same price is paid for cotton for domestic use as for foreign shipment. It is evident, therefore, that the growers, in applying only twenty-two pounds of bagging and ties to meet the requirements of domestic spinners, suffer an average reduction of thirty pounds to the bale and thereby sustain a net loss of practically eight pounds of lint cotton on every bale placed upon the market. As sixty-five per cent. of our cotton is shipped abroad, and as there is no difference in the prices offered for domestic or foreign shipment, the Liverpool requirements control the market. This is a matter which needs adjustment in order that a fair and just deduction for tare may be agreed upon, and the tare regulated on as light a basis of weight as will protect the staple and get it to the spinner in good condition. I would therefore urge your co-operation along this line, and if our cotton can be successfully compressed at the gin, we can deliver a neat package of uniform density and size with a minimum weight of tare which should apply to all bales alike, regardless of their weight.

STORAGE OF COTTON IN WAREHOUSES.

Pursuant to the organization of the Southern Cotton Association, there had been no direct concert of action relative to the building and equipment of adequate cotton warehouses for the purposes of storage and marketing the cotton crop by the growers. During the past two years, however, under the wide agitation and discussion of this important matter and its imperative need in the future handling of the South's staple crop, great progress has been made. Several hundred modern, up-to-date warehouses have been constructed at different interior market

points in the cotton states during the past eighteen months, and many hundred more are now in the course of construction or in contemplation of building. These local warehouses are being erected by local capital, subscribed by farmers, bankers, merchants and others, with a varying capacity of from 2,000 to 50,000 bales, according to the requirements of the various localities. As a general rule, they are built according to the plans and specifications of the Fire Insurance Companies, in order to give first class storage and reduce the present high rates of insurance to a minimum of expense. Our Association has conducted an active campaign of education along this line and assisted in this needed reform in the cotton industry in every way possible, with splendid results up to the present time, and continued bright prospects ahead. With the establishment of modern warehouse facilities throughout the interior of the cotton belt, practically all of the present difficulties which confront the growers in properly and intelligently marketing the crop to meet the demands of the spinners and minimize the growing and disastrous evils of speculation in cotton futures to the detriment of the legitimate cotton trade will be overcome. Aside from this, the heavy annual losses to both the growers and spinners from country damage and damp in cotton will be obliterated. With cotton warehouses built at every interior market point, the growers will soon begin their patronage and the staple will be promptly delivered from the gin to these first class storage facilities and there held in perfectly dry and good condition until sold and delivered to the transportation companies for shipment to the factory.

Furthermore, these warehouses will be placed in charge of competent, expert cotton men, who will grade the cotton and properly weigh it. A negotiable receipt will be issued with the grades and weights guaranteed and underwritten in such a way as to make these receipts negotiable in any financial centre. Such a cotton warehouse receipt, where the staple is properly stored and insured, will present a high type of gilt edge security to our banks and will at once command very cheap money.

This system will enable the growers to borrow money as needed on their cotton in storage to meet maturing obligations in the fall and winter, while it will further induce and enable the growers to sell the crop slowly and break up the present disastrous system of rushing the staple on the market during a short period of time when it is not needed for consumption.

This system will do more. It will ultimately enable the growers to get into cleaner touch and into more direct business relations with the spinners. With their cotton stored in warehouses, the staple graded and weighed, backed by a strong financial system and the introduction of first class business methods in the sale of the crop, they can begin to organize a system for taking orders direct from the spinners and be in position to execute these orders promptly and efficiently. This would be an ideal consummation of the future cotton trade of this country and I feel assured that from expressions already made by many of our leading spinners that they would enter heartily into an arrangement of that kind.

We ask your co-operation along all these lines, believing that such co-operation will hasten the day of the emancipation of both the spinners and the growers from the dominating influences of both the middlemen who buy our cotton for you and that extreme element of speculation which has in the past and is at the present time so hazardous to the legitimate interests of the cotton trade.

STABLE PRICES.

With a better understanding between the growers and spinners, with improved facilities for handling and marketing the cotton crop in the future the foundation can be permanently laid for the fixing and maintenance for a fair stable price for the staple which will be mutually profitable to both interests. I wish it distinctly understood that the great Association which I have the honor to officially represent as its official head, has no desire to undertake to force the payment of such a high price for cotton as that it would curtail consumption or prevent

the spinners and manufacturers from earning a fair and equitable dividend upon the investments which they have made in the great and useful industry they pursue. Our people are being taught to regard the spinners of the world as their best friends instead of their enemies as they were taught to do in years gone by. We realize that unless the spinners prosper our industry must suffer, and we ask the same degree of consideration at your hands. If we knew each year at what price you could profitably spin our cotton, we could more intelligently agree upon a price that would be more satistactory and upon which our present differences could be more quickly harmonized. The South at the present time cannot produce abundant supplies of raw cotton at a living profit for less than ten cents and if prices for any reason prevail below that figure, production will be necessarily curtailed and the spinning industry made to suffer from the reaction. The cotton growers of the South are not compelled to grow cotton at a loss for their future existence, but the cotton mills of the world must be kept busy with their spindles and looms constantly employed, in order to make their investments profitable. I am thus plain in my statements along this line because there is a constant and ever increasing effort to depress the price of our cotton down to or below the cost of production. With your interests so vitally affected in the future, and being, as you must be, so closely related to and with the growers in the cotton industry, we ask you in all candor and in all earnestness to join with us to maintain the price of the staple at fair and profitable figures to the growers in order that your industry may not be jeopardized and that the growers may have every inducement to push forward to wider and greater efforts in production so as to safely meet the ever expanding and increasing demand for American cotton.

We wish the highest measure of prosperity, not only to you and the capital invested in the cotton mills of this country, but also to that vast army of wage earners who make the success of your mills possible. We ask for the millions of cotton growers in the South, the same measure of prosperity in the life work in

which they are engaged. We realize that we possess a distinct monopoly in the world's production of cotton and have but few fears that the rights of this monopoly will ever be infringed upon from any other quarter of the globe. We would rejoice if the American manufacturers occupied the same strong position as that of the growers. The South is now financially able to protect the cotton crop from any future imposition of very low prices and the farmers will successfully resist any effort made to reduce prices below the cost of production, or even below a price that will at least net to them a profit.

With but one thought single to the future glory of our American Union, actuated by that sentiment which would tend to build up and make prosperous all sections of our country alike, let us join hands for the prompt and effective solution of those problems which so vitally affect this great industry of mutual concern and enjoy those benefits that should and must accrue to every interest legitimately concerned in the great staple crop of the world.

Mr. JOHN H. MARTIN. Mr. President, ladies and gentlemen: The paper just read, written by the President of the Southern Cotton Association, aptly mentions, I think, the change of feeling between the growers of cotton on the one side and the spinners on the other. Down South we used to look at you gentlemen as speculators and we thought the producers were in the attitude of the small boy in the story who asked another small boy for a piece of his apple and the other boy answered "No." Said the first boy, "Gim me de core." "Oh," was the reply, "dere ain't gwine to be no core." [Laughter.] In figuring it over, however, we concluded that perhaps we were more nearly like another small boy whose brother had been given an apple by his mother upon his promise that he should give a good part of it to his younger brother. Later she asked him, "Did

you give your brother some of the apple?" "Yes, I gave him the best part of it — I gave him the seed. He can plant them and have a whole orchard." [Laughter.] We began to think then that you would take the apple and the core, but would give us the seed to get another plant from. But as Mr. JORDAN said, that feeling is dying out and we are going to have an era of good will.

THE OUTLOOK FOR THE COTTON GROWER.

JOHN MARTIN, Paris, Texas.

Mr. President, last spring it was my privilege and pleasure, in company with your President, to accompany the Committee of English spinners in their journey through the cotton states, and a little later, in Washington, I met these same gentlemen, together with a number of representative American manufacturers and delegates from the Farmers' Union and Southern Cotton Association. I was at the Washington conference as one of the representatives of the Farmers' Union, for although not a member of the organization, I had been acting in an advisory business capacity for them. A few days ago I met Mr. MACCOLL in Providence, and he was kind enough to invite me to be present at your meeting.

I am glad to be able to bring greetings from the cotton growers to the cotton manufacturers, and what I shall say briefly today is with a view of bringing about what the cotton growers most ardently desire, viz., a better acquaintance and more satisfactory business relations between the two interests. It has long been the dream of the cotton growers to deal directly with those who spin their product; but they know that before they can induce you to change existing conditions, they must give you good reasons; and this is my mission today.

Agriculturally speaking, the South, taken as a whole, is the most productive section of our country, with fertile soil, moderate climate and possessing an energetic and hard-working population. I know this last assertion will be contrary to the accepted opinion of many persons who have never been in the

South, and who have an idea that the white man's burden there is to see that the negroes work. There never was a more mistaken idea. In the section with which I am most familiar, Texas and the territories, four-fifths of the cotton produced is by white labor. In one Texas county which has grown more than fifty thousand bales in a season, there is but one negro, a little girl, and in the territories the negroes number but a small part of the population. Negroes as a whole do not like farming, and the idle and the vicious among them drift to the towns and cities. Railroad construction and work around the saw-mills pay better than the planters can afford, with cotton at a low price. In all candor I say to you that there is no more industrious, hardworking and honest class of people in the world than the growers of cotton. There is no eight-hour day for them, their wives or their children, but rather, twelve, thirteen and at times fifteen hours a day, and this nearly the whole year around: and it takes nearly a year to break the ground, plant, cultivate and harvest a cotton crop. Indeed, I have seen picking and plowing going on in fields at the same time.

Why is it then, that the agricultural part of the South, with cheap lands, fertile soils, beneficent climate, a population intensely American, honest, frugal and hardworking, with a monopoly of the most valuable of all fibres, is yet to feel the impetus of prosperity and growing wealth that has so wonderfully blessed every other interest and every other section? There can be but one answer, — that the people who grow cotton do not receive in the price an adequate return for their investment and their labor. It is true that conditions have improved in the past few years; and it is also true that in many instances, lack of scientific farming and in all cases lack of scientific marketing, have had much to do with this lack of profit. WARREN HASTINGS, when impeached for high crimes and misdemeanors, while Governor-General of India, said in the House of Commons, "When I consider my opportunities there, I am surprised at my own moderation." Paraphrasing this, I might say that when the condition of the South at the close of

the war is considered, as well as the many obstacles that had to be overcome, it is surprising, not that the planters of the South have done so little, but that they have accomplished so much. They enjoy the unique distinction, I think, of having grown the only agricultural product ever taxed by the general government. They have received no direct benefit from the tariff laws. They cheerfully pay taxes for pensions for the union veterans; and it seems to them that all the world is against their effort to sell their product at remunerative figures. Long years of low prices so discouraged them that, finding it impossible to get ahead or often to keep out of debt, they got into a condition of almost despair, and too often failed to take care of their cotton after it was baled. But, as I said, conditions have changed of late years, and the tillers of the southern soil see better things ahead. They are making up their minds to better culture, better ginning, better baling, better plans for marketing and better prices. They have witnessed in other sections of our country the most marvelous advance in material prosperity that the world has ever seen, and they want some of it for themselves, their wives and their children. Help them, if you can, in this laudable endeavor, and do not permit them to drop back into the old condition of despair, if it is in your power to prevent it. For they are your fellow Americans, probably the most truly Anglo-Saxon population in the world, intensely patriotic, loving the flag and ready to fight for it, as was abundantly proven in the Spanish war. Because they are proud of being southerners, it does not follow that they are not proud of being Americans. There is no more intense American than President ROOSEVELT, yet when a Camp of Confederate Veterans at my home unanimously passed a resolution that I had the honor to introduce, inviting the President to be our guest when he visited Texas last year, an autograph reply from him not only expressed his pleasure on getting such an invitation, but in his letter he said, as though it was something to be proud of "I am half southerner myself," and he added that his mother had two brothers in the Confederate service, that he had

appointed a gallant ex-Confederate soldier Governor-General of the Phillippines, had sent the only grandchild of STONEWALL JACKSON to West Point as a cadet and had made JEB. STUART, Jr., United States Marshal in Virginia.

So we are all Americans, and should work together for the common good. You want to see our people and our section prosperous, and it is well to remember that we serve a useful purpose in keeping the balance of trade in our favor. Even now all business interests are anxiously waiting for the free movement of cotton to relieve a strained money condition.

I assure you that a friendly spirit on your part to the southern cotton growers will be amply repaid. You will find them reasonable, and not inclined to exact unreasonable prices.

At the Washington conference the cotton growers were anxious to learn what size crop would be needed for the coming year, and the manufacturers were curious to know what it costs to grow cotton. For obvious reasons it was impossible that definite information should be given on either point. It is generally supposed that the cost of growing cotton averages six cents to eight cents per pounds, depending on the season; but this is scarcely a fair estimate, as the investment and the planters' own time and labor are not taken into account.

There are two methods by which cotton can be produced cheaply, but I do not think your Association will stand for either. One is for the grower to take his wife from the house and his children from the schools to assist in making the crop; the other is to raise everything needed at home, and make of cotton the surplus, or money crop. This last would mean crops of six to eight million bales and twenty cents to twenty-five cents per pound.

I hope the time will come when representatives of all these organizations of spinners and cotton growers can get together, say in January, and discuss the question of acreage — what the world needs in the way of cotton — and later on, after the frost, the question of maximum and minimum prices. If they can get pretty close together and keep the price on a fairly even keel it will be better for both interests.

The Farmers' Union is now a business organization prepared to effect transactions in a businesslike way. Except in southern Texas, cotton is moving slowly, but on my return to the South we will be prepared to offer cotton by description or by actual samples, with ample and satisfactory guarantees of shipment, time, class, weight and condition; for without all these, and indeed without a system that we think will be an improvement on those exciting, we know we cannot expect direct business relations with the manufacturers.

It may interest you to know that our plans have been endorsed by a number of the leading British spinners, and I shall hope that we will meet with equal good treatment at the hands of the manufacturers in our own country. [Applause].

The PRESIDENT. There is now an opportunity for discussion of these two papers. It will be proper, I think, to have some expression of opinion from manufacturers in regard to the subject matter. Perhaps Mr. KNIGHT and Mr. MONTGOMERY, who were at the Washington Conference may have something to say. I would like to ask Mr. MARTIN how many members there are in the Farmers' Educational and Co-operative Union of America.

Mr. JOHN MARTIN. About 600,000, as near as we can get it, covering all the cotton growing states and some in Kentucky.

The PRESIDENT. And are these all cotton growers?

Mr. JOHN MARTIN. More than half a million, I think, are cotton growers; practically all of them. They are organized into state unions.

The PRESIDENT. How many bales on an average would you say half a million growers raise?

Mr. JOHN MARTIN. It is hard to say. Most of them are small growers. I should not like to make a guess at it, but they raise a great deal of cotton.

Mr. ARTHUR H. LOWE. Mr. President, I would like to ask Mr. MARTIN if we are to understand that the organization is ready to do business, that is, to buy and sell cotton and deliver cotton to buyers?

Mr. JOHN MARTIN. Yes, sir.

The PRESIDENT. Mr. KNIGHT, have you anything to say?

Mr. STEPHEN A. KNIGHT. I sympathize with Mr. MARTIN and the parties he represents. It would seem that if the spinners and the growers of cotton could get together and trade themselves and leave out the various middlemen and speculators, it would be for the mutual benefit of both planter and manufacturer; and it would seem to me, with the better feeling that is expressed between the manufacturer and the cotton grower, that the course is not only possible but probable. I feel that that meeting that we held in Washington to consider this subject has been productive of much good and I heartily wish that more meetings might be held in the same line to follow out the suggestion that was made by the two parties at that time, and that we might eliminate distance and bring ourselves in close connection with the producers of cotton in our purchases. There is a class of people who do not do a legitimate business; there is a class of people in the market dealing in the material so that we manufacturers are kept all the while in a state of turmoil, we do not know when to buy or when to sell, and very likely the planters suffer in the same way. I would like very much if something could be brought about to do away with this evil. Mr. MARTIN, I understand, is here to consult with manufacturers, and it seems to me, that if he can give a proper guarantee of the quantity and quality and the time of

shipments, something might be done in that line. I sincerely hope that something of that nature may take place.

Mr. J. R. MONTGOMERY. I think it was fully expressed at the Washington meeting referred to that there was complete sympathy between the manufacturers and the cotton growers, but we did not learn at that time and I fail to see now just how we can get at the matter practically. For instance, if I want to buy 200 or 300 boles of cotton, good middling, 1⅝ inch staple, delivered at my mill, how am I going to get in touch with these people? If we knew that they were organized and in a position to send their sales agents out or let us reach them in some way, something might be done. Now is the time we begin to buy cotton and we are in shape to do business, and I think there are quite a number of manufacturers who would like to do business with them, if Mr. MARTIN will kindly inform us how to get at it.

Mr. JOHN MARTIN. Mr. President, may I answer Mr. MONTGOMERY briefly? I think as a business proposition it would hardly pay to take your time to go into detail, but I say this: I know, having been in the business thirty years, that it is not worth while to come to you with a proposition that is not workable and more satisfactory to you than existing conditions. We want to make a start this year and eventually there will be something doing. We propose to lay these matters before the spinners individually and we hope that we will be able to show you a fair working proposition so that you can get what you want. There will be a guarantee behind every stipulation as to time and condition, as to weights, grades and everything else, claims, if any, to be promptly settled on the spot, and all in regular businesslike shape. There are so many details that it would take me all night to explain our plans wholly, and I know your time is valuable.

Mr. J. R. MONTGOMERY. Well, shortly, in a few words, could

you say if you are now organized and in a position to take up the matter?

Mr. JOHN MARTIN. We are organized in Texas and my headquarters will be in Houston, where we have a large central compress and warehouse; the finest plant, I think, in the South, except perhaps the Chalmette property. It cost $200,000 and covers many acres of ground, and we are ready to receive shipments for concentration from the local warehouses and interior shippers. They will be classed by experts and sold there as the owners direct. We do not know just how soon the business will start, but in a few weeks. I really did not come East for this meeting. I had other business in New York and I met the President in Providence and he asked me to come, and I found that I had the time and was very glad to come. In a very little while you will be able to make a start in doing business with us at least in Texas and the territories. We expect to work together and we are in a position to do business from those points, and it will be done properly or not at all.

Mr. J. R. MONTGOMERY. Could Mr. MARTIN tell us how we are going to fix prices?

Mr. JOHN MARTIN. No, sir, I cannot; I don't think anybody can.

Mr. J. R. MONTGOMERY. I was wondering, so as to make this matter satisfactory to the Southern growers and also satisfactory to the Northern manufacturers and to the market, how are we going to adjust prices so as to get rid of speculation?

Mr. JOHN MARTIN. I don't think that can be done, at least, not without discussion and co-operation. It will be a matter of consultation in the beginning of the year as to the amount of cotton that will be needed, and then again after frost, a minimum and a maximum price, varying say a cent a pound, perhaps from 9 to 10 cents or from 10 to 11 cents. The way we are doing business now, we have a central warehouse and a number

of local warehouses from which this cotton is concentrated and sold as the growers want to sell it. A great many of them will sell at the current prices.

Mr. J. R. MONTGOMERY. That was just the point I wanted to get at. I want to know how you are going to get at these current prices.

Mr. JOHN MARTIN. Well, you take the market for that, you know. You make the market.

Mr. J. R. MONTGOMERY. But the speculators are making the market.

Mr. MARTIN. I don't see how you are to get rid of them. [Laughter.]

Mr. J. R. MONTGOMERY. I wish we might but I don't see how.

Mr. STEPHEN A. KNIGHT. It seems to me, Mr. President, that it is up to the planters to devise some plan by which the manufacturers can deal with them. The planter today owns the cotton; we own the mills. We cannot run the mills without cotton; we cannot buy the cotton of the planter until he makes terms and conditions on which we can buy it. Until such time as they can make a proposition that is satisfactory and practical it seems to me that the spinner, in order to keep his spindles running, will be obliged to buy the cotton of the dealers as he has in the past. Therefore, I think the matter of purchasing cotton of the planters direct is entirely up to them, and so soon as they can devise some plan whereby we can trade intelligently we will be only too glad to meet it. [Applause.]

The PRESIDENT. We have another very interesting paper to listen to this evening, on the subject of Egyptian Cotton. It is to be presented by a gentleman who is a partner in the largest importing firm of Egyptian cotton in this country, — Mr. ARTHUR A. HASERICK of Boston. [Applause.]

EGYPTIAN COTTON.

ARTHUR A. HASERICK, Boston, Mass.

It seems but a short time ago that Egyptian Cotton was to most American spinners a comparatively unknown article. The peculiarity of the various growths, the planting of the crop, the ginning and baling were all matters to which American spinners as a whole gave but little of their attention. Today, however, the situation has entirely changed and Egyptian Cotton may be said to occupy here very much the same position as it does in England, and users have become quite familiar with the various growths which that country produces.

Much has been written on the subject in American textile papers and only recently a very able address by Mr. S. H. CARVER of Alexandria was delivered before the American Cotton Manufacturers' Association at Asheville, N. C., which in a few words gave a great deal of valuable information regarding the manner of handling this product of Egypt. Anyone at all familiar with the subject, particularly if he has visited Egypt, cannot fail in being impressed with the method and system employed throughout and this is particularly noticeable when compared with the usual custom of American cotton growers. It is not going too far to say that Egyptain Cotton would not have found in the United States such a ready market had domestic growers been less lax in their methods. It has often been suggested that Egyptian Cotton could be grown in the United States and in point of fact a few enthusiasts with the assistance of the Agricultural Department have planted the seed. The result obtained, however, had very little resemblance to the

real thing and whatever resemblance may have existed was to a large extent destroyed by the poor ginning and handling. The success of the Egyptian Cotton industry may be explained by the one word, THOROUGHNESS. England has done much for Egypt and not the least of her achievements are to the improvement of the remarkable irrigation system, upon which everything depends and the business like methods established for the growing and trading in cotton. In Egypt we have a system which is complete. The sowing, picking, ginning, baling and shipping are all matters which have been studied with a view of arriving at perfection. Mistakes, of course, are bound to occur but they are comparatively rare and it must be borne in mind that many of the growers and head men are Arabs, who, as is well known, consider what we would term dishonest trading to be a perfectly legitimate thing, but there are provisions to guard against this, it is a part of the system, with the result that any dishonesty when detected is a very serious matter for the parties involved.

FIGURE 1.—COTTON GINNING AT MEHALLA-KEBIR, EGYPT.

When the new crop is ready to come to market, the Alexandria General Produce Association determines upon a type out of the crop to be considered as "fully good fair," the basis for all transactions. The sample selected is divided, one portion being placed under glass in the rooms of the Association, which on no account must be taken out until the following year. Another portion is left open to inspection under special conditions. In the event or any dispute arising between the buyer and seller these samples may be referred to, and if an amicable arrangement cannot be arrived at the matter comes up before the Board who give their decision, which is final. In case of any trickery on the part of the seller the conditions imposed are such that make it difficult for him to continue business.

A feature about Egyptian Cotton is the uniformity of quality. This may be explained by following the system throughout from the beginning. In the first place large ginning factories have been erected at the important centers, being owned chiefly by different large shippers. The cotton is bought by these establishments in the seed from the surrounding districts and when a sufficiently large quantity of it has been secured, it is inspected in the factory yard and is there graded preparatory to ginning. Some of these factories it may be pointed out have a production equivalent to about 300 Egyptian bales per day. The gins are generally arranged in two rows, feeding inwards. When a batch of cotton is ready for ginning it is fed into all of them simultaneously and delivered on to trucks running on a railway between two lines of gins. It will be observed that the whole of this cotton, after being graded before ginning, which is important, receives a most thorough mixing by the manner in which it is delivered from the gins. From here it is taken to a press and put up in bales weighing approximately 800 pounds, but which are about twice the size of the regular shipping bales such as are received over here. These large, or country bales as they are termed, are brought to Alexandria by means of canal and here they are again examined, graded and classified. When a lot of several hundred has been made up, all

FIGURE 2.—EGYPTIAN PRESSING COMPANY, ALEXANDRIA, EGYPT.

of them are entirely opened and given a thorough mixing in the large apartments intended for that purpose in the buildings of the Egyptain Pressing Co. The cotton is then ready for the final pressing. The number of bales resulting from this operation varies, but it generally consists of several hundred. The machines for the final pressing are rather formidable, being a combination of steam and hydraulic power; each is fitted with three bins, two of which are being filled with the loose cotton, while the third is under pressure. They are arranged to revolve so as to come under the press as required. Before the cotton is placed in the bin the covering is inserted, steam is then applied to the machine and when this has reached its extreme limit eleven hoops are put on. A further pressure is then applied by

hydraulic force, and this enables the attendants to buckle the hoops. The bales expand as the pressure is released, making the hoops absolutely tight. In this condition they are thrown down a shute and with the exception of the ends, which have yet to be sewn on, they are ready for shipment. The capacity of a press of this description, running under favorable circumstances, is from fifty to sixty finished bales per hour. A good quality of burlap of uniform weight is used for covering purposes so that the tare seldom varies from the fixed standard of twenty-two pounds.

While it is admitted that the cost of baling is greater than that adopted in America, on the other hand there is a large saving in the matter of freight. (Ships that can pack 10,000 or 12,000 bales of Egyptian cotton can only take from 6,000 to 8,000 bales of American cotton, although, according to the ratio of weights, they should take 14,000.) There is practically no loss or damage to the cotton in transit and the insurance is naturally less, on account of the limited risk of cotton packed in this manner.

It is difficult to see, having in mind the well known American enterprise, why some such system cannot be applied to cotton delivered from the South. The cost of installing a pressing plant, such as is used in Alexandria, is, of course, considerable. On the other hand, were this system adopted here there would be a distinct advantage, and if care were taken in grading and mixing the bales before packing, it is possible that a premium on the cotton thus handled could be obtained. It would be an advantage to the mills to know that one sample taken out of a bale would fairly represent the lot, as is the case with Egyptian cotton.

Until a few years ago all of the final pressing was done in Alexandria, but of late years it has been found an advantage to have smaller establishments in the country and there are several such now in operation which are mostly controlled by merchants who ship their cotton direct, and who do not offer it for sale in Alexandria, since steam pressed bales cannot be

delivered against sales of contracts except under very onerous conditions.

The seed obtained by the ginning factories is usually shipped to Hull or some English port for pressing, but with a view of keeping up the quality of the crop it is now customary for ginners to set aside the seed of any particular lot that shows up well and distribute the same for planting the following year. This custom has done much to preserve the quality of the crop. The buying of the cotton in the seed is considered a very important point as it enables the purchaser to do his own ginning, and also to see that it is done right. Small ginning establishments such as are found in the southern states, whose only interest is to separate the lint from the seed at any cost to

FIGURE 3.—DELIVERY FROM MIXING AND DUSTING MACHINE.

the fibre, do not exist in Egypt. The Egyptian system may be more expensive than the American, but on the other hand, the ginner realizes that there is sometimes a difference of cents per pound between good and bad ginning, and he intends to get all the value he can out of the cotton. The fact that all of the Egyptian crop is watered regularly by artificial means has much to do with the uniformity of the fibre. With the improved methods of the irrigation system, water is now more abundant than formerly, in fact it is occasionally found that crops are damaged by too much, or injudicious, watering. The cotton plant on the whole is a hardy one, and will stand comparatively long periods of drought, but when too much water is applied the plant is inclined to favor the leaf rather than the pod. The water is lifted from the canals by the same primitive native methods which have existed in Egypt for centuries, and is allowed to flow through smaller channels into the fields.

The dam recently constructed at Assouan has done much to increase the water supply and prevent drought. This, however, is not sufficient for Egypt's requirements, and further extensive works are now contemplated. When these are constructed it will mean that in the course of time a larger cotton acreage may be looked for. As a result of the Assouan dam the area under cotton in Upper Egypt, that is to say, the country south of Cairo, has already increased, and the cultivation is now extending into the Soudan, which is producing to a limited extent some very desirable cotton which in the course of time will improve. Ten years ago the crop of Upper Egypt was approximately 250,000 cantars.* Now it is 1,000,000 cantars and it may increase, perhaps, at least half as much again when the irrigation scheme is completed. The effect of the dam upon Lower Egypt is proportionately less as regards the extension of growth, but it has secured a better water supply for the crops during the spring and early summer months, and some waste lands are now being washed and reclaimed.

A few years ago it was customary to plant cotton on the

* A cantar is about $98\frac{1}{2}$ pounds.

Delta lands once every three years, the other years being used for a rotation of crops generally ending with birseem, a plant similar to clover, being the fodder of the country which gives back to the land that which the cotton plant had removed, for it is well known that cotton weakens the soil. At that time no fertilizers were used, but of late years it has been customary in some districts to fertilize the land before sowing, in which case it was not necessary to rotate the crops as formerly, so that in this way the area under cotton has increased and the planters have availed themselves of every opportunity of meeting the increased demand. On the other hand the production per acre of lint cotton has shown a marked falling off. In 1905 the average yield per feddan, which is equivalent to $1\frac{1}{16}$ acre, was about 395 pounds. In Mr. CARVER'S paper he states — "It is a regrettable fact, and one that calls for reflection, that this yield compares very unfavorably with former years. The cotton crop in Lower Egypt in the year 1897 was in quantity 15 per cent. more than in 1904 and 1905, while it is but a moderate estimate to put the area under cotton in these last years, to be 20 per cent. larger than in 1897, thus the total comparative deficiency of yield is fully 35 per cent."

The tendency has also been toward planting cotton closer together in order to obtain more plants per acre. This, however, had been found detrimental to good results. The problem now is to find a way of increasing the crop to meet the demands and at the same time keep up the quality.

In regard to the possible developments of the Delta crop, based upon the result eight years ago when cultivation was doing well and when the Delta yield was about 6,200,000 cantars, one might estimate a further possibility since then, with good cultivation, of an eventual 30 per cent., making a crop of about 8,000,000 cantars.

The Mit Afifi seed, which forms the greater part of the Delta crop, is gradually deteriorating and the matter of producing a new growth is now the problem which the Agricultural Society, with the aid of certain individual cultivators, is trying to solve.

It may not be generally known that Mit Afifi was introduced about fifteen years ago from a single freak plant discovered in the fields. It arrived just at the right time, for Gallini, Ashmuni and other growths were failing. The deterioration is the natural result which must come after some years, if strict measures for re-selection are not used. Although this has been partially recognized for sometime past, and some representations have been made to the authorities, it is only recently that the question has been seriously faced. Mit Afifi may still have many

FIGURE 4.—FILLING THE BINS.

more years to live, and it is to be hoped that by that time a good substitute will be found.

The next growth of any importance today is Yannovitch — a cotton with a particularly fine, silky fibre, much lighter in color than Mit Afifi, though somewhat darker than Sea Island, for which, however, it is found to be a very good substitute. It is a mistake to suppose that this is derived from Sea Island seed,

or that American seed is planted in Egypt. It is true that experiments were made with Sea Island some years ago, with the result that a very long fibre, quite two inches in length, was obtained, without, however, any strength. In other words, American seed is as unsuited to Egypt as Egyptian seed is to the Southern States.

Still another growth is Abassi, which is a pure white cotton having all the other characteristics of the Egyptian staple. It is quite distinct from what is termed the "old white Egyptian" which was a cotton grown in the neighborhood of Zifteh, in the Delta, with a rather rough fibre more resembling Peruvian. The cultivation of Abassi, however, and of other growths with the exception, of course, of Mit Afifi, has not received much encouragement owing to the fact that the production per acre is small, and that the cultivation is more difficult on account of the plants being less hardy.

The most recent growth in the Delta is Nubari. Compared with Mit Afifi it is a strong cotton, very classy and more costly. It ranks between Mit Afifi and Yannovitch, but the crop at the present time is only a small one.

The crop of Upper Egypt is Ashmuni which, however, must not be confused with the crop of the same name which was formerly planted in the Delta. Compared with Mit Afifi it is lighter in color with a somewhat coarser fibre. The cotton during recent years, on account of the better water supply, has shown much improvement, and is now being successfully worked by a number of American spinners who are beginning to appreciate its merits.

Mit Afifi seed has been tried in Upper Egypt, but, up to the present, cultivation generally in that part of the country has not succeeded, from what reason it is not certain, but it is probable that one reason is a deficient experience in cultivating this growth. Cotton cultivation in Upper Egypt has only grown to some importance during the last few years, and there is still evidence that it is not carried out as well as it might be. One may hope that with the growing importance of the crop there will be improvement in this respect.

Referring again to Mit Afifi, what gives ground for hope that it can be successfully cultivated in Upper Egypt, is the fact that a few enlightened cultivators have had successful crops. Still even these are not quite settled in their opinion as to its being suitable for the soil of that country. There is, therefore, more to be learned upon this. It is an interesting question, as the cotton crop of Upper Egypt will still increase further as more basin land is converted into summer cultivation.

Attention is now being directed to the Soudan, but the devel-

FIGURE 5.—EGYPTIAN COTTON PRESS.

opment will be a long matter as a large irrigation scheme is required. The government has rightly decided that nothing must be done in the Soudan which shall prejudice the supply of water required for Egypt. This means that a quite insignificant quantity of water may be drawn from the Nile after January 31st of each year, in order that the bulk of the supply may come down to fill the Assouan reservoir and give the early summer supply for Egypt. The Nile begins to rise about July 1, and

comes to its height in October. The Irrigation Service has calulated the quantity of water that may be spared, and has granted rights for pumping onto a few thousand feddans. Beyond this no pump may work after January until the new water comes in the summer. This naturally is a considerable hindrance to cultivation. The remedy will come when a scheme for holding up water in the Soudan has been planned and executed, which is a matter of extreme magnitude. At present, therefore, the Soudan

FIGURE 6. — EGYPTIAN BALES IN BOSTON.

cotton cultivation cannot be looked upon as an important factor. Small experiments have shown that the land can produce cotton of good quality, from Mit Afifi, Yannovitch and Abassi seed, thus giving hopes for the time when the conditions of the climate for its cultivation are better understood, and when the water supply can be improved. The Soudan is extensive and conditions vary in its different parts. The economic condition of the country has been very materially improved by the construction of a railway from Shendi, near the junction of the River Atbara and the Nile, to Suakin on the Red Sea coast. This railway will reduce the cost of transport between the Soudan and Europe

to a comparatively moderate figure. The scarcity of labor which now prevails will doubtless be remedied during the time required for executing irrigation schemes.

In closing, a few words may not be out of place respecting the effect of the dam at Assouan. It will be remembered that this great engineering work was completed in the year 1902, and the crop of the following year was the first to be benefitted. It was constructed chiefly with the view of protecting the land under cultivation, and while it was not expected that there would be any material increase in Lower Egypt, it was recognized that the land of Upper Egypt would be chiefly benefitted. This of course refers to a narrow strip about 600 miles long and a few miles wide, but the soil is rich, and with a regular supply of water crops could be depended on. Beyond this strip, and this applies to all land which cannot be reached by the Nile water, there is nothing but a sandy desert impossible for cultivation. The following table will show the land under cotton during the past few years:

	Lower Egypt.	Upper Egypt.	Total.	
1902-3	1,125,476	83,341	1,209,017	Feddans.
1903-4	1,134,380	156,000	1,290,380	"
1904-5	1,162.519	243,409	1,405,928	"
1905-6	1,213,988	328,600	1,542,588	"

From this table it will be seen that the acreage of the Delta has increased, but not to such a marked extent as is shown in Upper Egypt. On the other hand, as already pointed out, the production of cotton per acre has been reduced. The following is a list of the crops for the same period:

1902-3	5,838,000	cantars.	
1903-4	6,509,000	"	
1904-5	6,352,000	"	
1905-6	5,900,000	"	(estimated)

It is, therefore, apparent that the increased area has not been followed by a proportionate increase in crops. To go still further back — the crop of 1897-8 was 6,543,000 cantars, that of 1899 and 1900 only a little less, and neither of these had the

benefit of the dam. Every effort is now being exerted to increase the supply in order to meet the demands, but it is quite evident that for sometime to come the requirements can only be met with difficulty.

Mr. WILLIAM D. HARTSHORNE. This has been an extremely interesting paper and I would simply like to ask one or two questions that I have seen broached elsewhere in regard to the possible reason of the shortness of a crop — that is, the less production per acre — which possibly Mr. HASERICK can give us some light upon. One point he raised may possibly account for it, and that is the lack of rotation in crops, but I have heard it questioned whether or not the holding back of the water by the dam was not holding back the fertilizing qualities of the water and thus causing a less production. Perhaps MR. HASERICK can give us some information in regard to it.

Mr. ARTHUR A. HASERICK. I have heard that remark made with reference to the water. The dam, which is about 7,000 feet long and 92 feet high, holds back a vast amount of water, and the idea was that the sediment or deposit would remain there. But that deposit is a floating deposit; it is vegetable matter chiefly. It originates, I think, away up the Nile by the Nyanzas, in what they call "sud," which is a floating vegetable matter. I think you will find that in the water the bulk of that fertilizer is floating. Of course, just before the Nile rises the gates are all opened. There are 180 gates in the Assouan dam, each about 26 feet high, and those are all opened wide and whatever may be left back of the dam is then allowed to pass out. I do not believe that is the reason for the inferior condition of the seed. It is following the same course as Gallini, Ashmuni, Bamia and all the others.

The PRESIDENT. There is one curious thing about the spinning of Egyptian cotton that I have not been able to solve. I find in talking with English spinners that they all say that they get stronger yarn with Egyptian than American, and in talking with American spinners they all believe that they get stronger yarn from American than from Egyptian cotton. I do not know what the solution of this problem is. Perhaps you can explain it, Mr. HASERICK?

Mr. ARTHUR A. HASERICK. I am not a spinner, Mr. President.

The PRESIDENT. It is a hard point. There must be some reason for it.

The SECRETARY. The Committee on Resolutions, of which Vice-President HARTSHORNE is chairman, are ready to receive communications from any persons who have resolutions or the subject matter of resolutions to present to the Association.

Adjourned to Thursday morning, September 13, at 9 o'clock.

After the adjournment an informal reception was held in the parlor of Hotel Champlain, when the members and guests were presented by members of the Committee on Meeting to President JAMES R. MACCOLL, Mrs. GEORGE P. GRANT, Jr., Vice-President WILLIAM D. HARTSHORNE, Mrs. WILLIAM H. LOFTUS, Vice-President and Mrs. GEORGE A. AYER, ex-President and Mrs. ARTHUR H. LOWE, ex-President STEPHEN A. KNIGHT and Secretary and Mrs. C. J. H. WOODBURY. The reception was followed by dancing for which music was furnished by the orchestra of Hotel Champlain.

THIRD SESSION.

THURSDAY MORNING, SEPTEMBER 13, 1906.

The Association met at 9 A. M., President MACCOLL in the chair.

The PRESIDENT. I have pleasure in presenting Mr. C. B. BURLEIGH of Boston, who will read a paper on The Curtis Vertical Turbine.

THE CURTIS VERTICAL STEAM TURBINE.

CHARLES B. BURLEIGH, Boston, Mass.

The steam turbine has not been prominently brought to the attention of the Association since the Lenox meeting.* October 1, 1903, since which time its development and introduction has unquestionably placed it far beyond what, at that time, was considered by many as its experimental stage, as is evidenced by the fact that orders have been placed for nearly seven hundred (700) Curtis turbines approximately aggregating one million horse-power capacity, of this amount some three-quarters of a million horse-power are in successful commercial operation.

This vast development may become more apparent to you by bringing to your notice the fact that there are today in commercial service Curtis turbines of sufficient capacity to displace every steam engine in use for driving textile mills in the United States as shown by the census of 1900, which present the latest available figures.

When we pause to consider that the first Curtis turbine to be put into commercial service did not leave the factory of its manufacturers until February 24th, 1903, and that this result has been accomplished in three years, it is beyond argument that this particular form of prime mover must possess advantages over other power producers designed to accomplish similar results.

It is the object of this paper to present for your consideration some of the results which it is possible to produce by the use of the Curtis steam turbine, avoiding, as far as possible, any comparison with reciprocating engines or turbines manufactured

* Advantages of Steam Turbines for Textile Mills, Transactions, Vol. 75, Page 170.

by other concerns, leaving this matter of comparison to your own further investigation as to whether or no they are capable of similar results.

HISTORY.

It may not, at this point, be out of place briefly to review the development of steam prime movers.

It may surprise you to learn that the earliest record which history gives of apparatus designed for the mechanical utilization of the energy of steam is contained in a manuscript written by HERO of Alexandria, Egypt, about 120 B. C. entitled "Spiritalia Seu Pneumatica".

In this work he describes what he terms an "Aeolipile," which was evolved by the Egyptian priests. He makes no mention of its application but describes it as a hollow sphere supported by and free to rotate on two trunnions.

On the Equator of the sphere were attached bent pipes connecting with the interior. Steam admitted through the trunnions to the interior of the sphere escaped through these bent pipes and on coming in contact with the atmosphere, reacted on the sphere causing it to rotate.

This was a reaction steam turbine and from the description it will be noted that the first record we have of the utilization of the energy of steam resulted in the production of rotary motion.

About 1550, HERONYMUS CARDAN a physician, mathematician and mechanic, called attention to the expansive power of steam and the vacuum which could be produced by condensation.

In 1569, JACOB BESSON, a French professor of natural philosophy, published a treatise on the generation of steam and its properties.

In 1571, MATTHESIUS, in a sermon spoke of a small quantity of confined vapor.

In 1606, GIOVANNI DELLA PORTA published a treatise on Pneumatics and called attention to the fact that the condensation of steam could be used to produce a vacuum and "suck up" water from a lower level.

In 1629, GIOVANNI BRANCA of Loretto, Italy, a physician and architect, designed the first steam turbine, the mechanical output of which was applied to useful purposes.

Steam was generated in a boiler and escaped to the atmosphere through a tube.

The steam in expanding from boiler pressure to atmospheric pressure, acquired speed and in discharging impinged upon a series of paddles secured to the periphery of a wheel which in turn was secured to a shaft free to rotate.

This was an action or impulse steam turbine.

This second method was far superior to the first, as the application was far more direct and much more simple.

In 1663, the Marquis of Worcester, published a description of a crude method of elevating water.

During the period from 1698 to 1702, THOMAS SAVERY invented what was termed a "fire engine" for raising water from mines.

In 1705, DENIS PAPIN designed a modification of the Savery Engine which was the first non-condensing, single-acting steam pump and the earliest development of steam apparatus of the piston type.

He also designed the first fire-box boiler which he described as follows: "burning fuel on a grate in a furnace with a down draft of air entering above the grate, passing downward through the fire, and from the ash-pit to a side-flue in the chimney."

He claimed "perfect combustion, absence of smoke and saving in fuel."

To those familiar with the modern "down-draft boilers", these claims appear quite up to date. In the same year, 1705, THOMAS NEWCOMER, a blacksmith and associate of SAVERY'S designed and built a single-acting steam engine, one of which is today in operation a few miles out of Glasgow, for raising men and material from a coal mine. This engine consists of a cylinder some seven feet in length and thirty-two inches in diameter using steam at eight pounds pressure. The cylinder is jacketed and provisions are made for admitting water to this

jacket. The operation is somewhat as follows: A lever is provided which in one position opens the steam supply and closes the water inlet. The steam admitted to the cylinder expands against the piston and raises it. The operator then throws the lever in the opposite direction closing the steam supply and opening the water inlet. The water at a low temperature coming in contact with the cylinder condenses the steam causing a vacuum which draws the piston back to its original position. This piston connected to a walking beam actuates a drum which raises the load. The engine has been in continuous operation for the last two hundred years.

It will be noted that its working requires the undivided attention of the operator, who states that he has had charge of its operation for twenty-five years and that it has always been handled by his ancestors.

In 1769, JAMES WATT took out his first patent but it was not until 1778 that his engine was made to produce rotary motion.

From the foregoing it will be noted that rotary motion was first produced by steam about 120 B. C. and it was 1778, almost two thousand years later, before the earliest form of modern steam engine for producing rotary motion was evolved.

It will also be noted that the steam turbine antedates the reciprocating engine by the same number of years. During one hundred years from the James Watt engine, using steam at from 30 to 40 pounds pressure per square inch and rotating at a maximum speed of 30 revolutions per minute, the modern reciprocating engine, using steam at pressure from 80 to 200 pounds and operating at speeds from 50 to 400 revolutions per minute has been developed.

For some two hundred and fifty years the idea of the turbine was laid aside and practically forgotten, until some twenty years ago (about 1883) when CARL DE LEVAL of Sweden and in 1884 the Honorable ALGERNON PARSONS of England, appreciating the fact that maximum economy from reciprocating motion had been very nearly, if not quite, reached, directed their attention back to first principles and undertook the investigation of the

ideas as exempliged by HERO and BRANCA, namely, the direct production of rotary motion by means of steam.

The investigations of each of these gentlemen resulted in the development of a successful steam turbine, but in both cases the resulting rotative speed was so excessive as to make the transmission of their mechanical energy almost prohibitive by any method available at that period.

Some fifteen years ago the design of the electric generator had reached a stage which permitted of its adaptation for use in connection with the turbine for making its output available for distributing purposes.

Some ten years ago, one of the large electrical manufacturing interests in this country, appreciating the possibilities for the future development of the turbine in connection with the generator, secured rights under the Parsons patents. About the same time Mr. C. G. CURTIS of New York, began the experimental investigation of the subject and later associated himself with the manufacturers of what is today known as the "Curtis Turbine" the first one of which was shipped from the factory of the manufacturers completed and ready for service February 24th, 1903.

After this historical resumé let us approach the development of the steam turbine.

DEVELOPMENT.

In the design of the Curtis turbine, rugged construction was first sought and efficiency made dependent on rugged design. The Curtis turbine is an impulse or action turbine of the Branca type, that is to say, the wheel or wheels are actuated by steam expanded in passing through a nozzle or nozzles, which, acquiring velocity by expansion is brought in contact with suitable buckets or vanes secured to the periphery of a wheel or wheels. The contact between the steam and the buckets results in the steam giving up a part or all of its velocity to the buckets thus actuating the wheel which being secured to the shaft causes it to rotate at a speed dependent on the action of the steam and the radius of the circle through which the bucket moves.

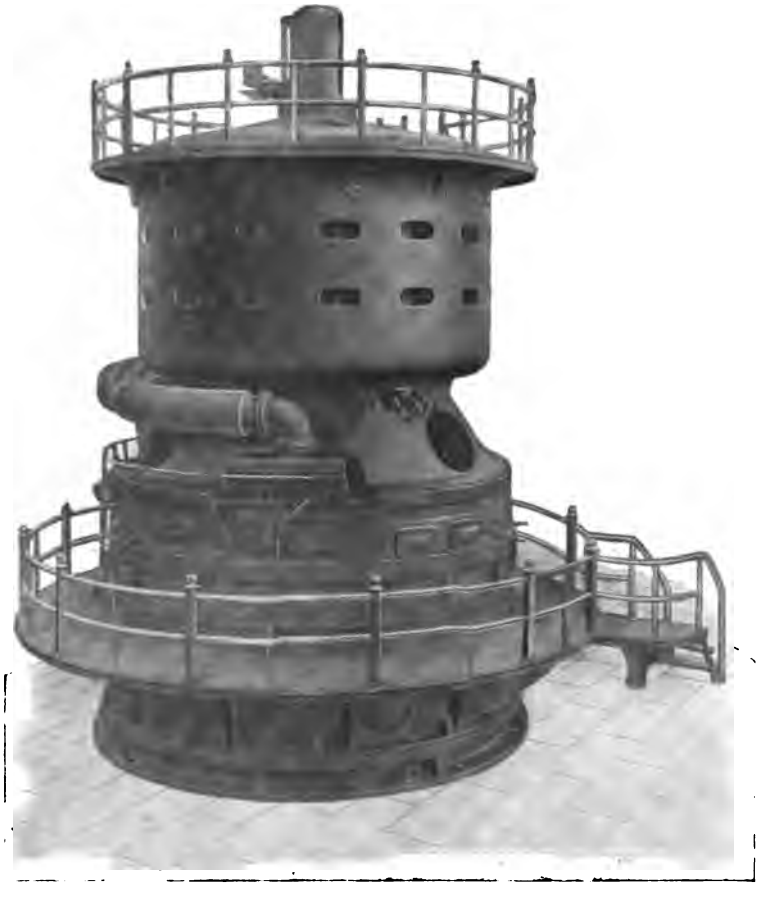


FIGURE 1. — 5,000 KW. CURTIS STEAM TURBINE DIRECT CONNECTED TO 5,000 KW. THREE PHASE ALTERNATING CURRENT GENERATOR.

The Curtis turbine bears a strong resemblance to a water wheel and most of the principles involved are applicable to both. The widest difference however, between steam and water is in the speed at which they move under pressure.

The velocity of a jet of water at 150 pounds pressure per square inch, which is equal to a head of 346 feet, is approximately 149 feet per second, while steam expanded from 150 pounds pressure per square inch to the pressure of the atmosphere attains a speed of 2,950 feet per second and if expanded into a 28 inch vacuum can attain a velocity of 4,010 feet per second. It will, therefore, be noted that the speed of steam is 19 times that of water at 150 pounds pressure.

There are certain fixed laws governing wheels actuated by fluids which are productive of the best results: the buckets should to produce the best results, move at one-half the speed of the fluid which actuates them and any departure from this condition results in lessened efficiency. There should be no shock between the buckets and the fluid, no sharp angular deflection to suddenly change the direction of motion of the fluid; there should be as little friction as possible between the buckets and fluid.

There are many other characteristics of importance which will become apparent as we continue.

VELOCITY OF STEAM.

As in actuating the turbine we are interested only in the velocity and volume of the steam and have no interest in the expansion other than for the production of the resulting speed and from the fact that until the comparatively recent development of the turbine, steam engineers have paid little or no attention to this characteristic, it may be well to briefly discuss it.

Let us consider a given volume of steam at a given pressure, confined in a vessel surrounded by a similar vessel in which the pressure is equal to that of the steam in the inner vessel. For the sake of simplifying the illustration disregard tem-

perature. If we effect an opening in the inner vessel no steam will escape into the outer one, for the reason that the pressures are balanced. Now, if by any means we lower the pressure in the outer vessel equilibrium is destroyed and the steam immediately expands to this lower pressure, just as it does in the engine cylinder behind the moving piston.

The steam cannot expand without displacement of the medium before it and the energy of expansion is utilized in producing motion in the steam mass.

The steam in its confined state was possessed of potential energy and on expanding a part of this potential energy was converted into kinetic energy or velocity.

It is a fact not generally appreciated that this kinetic energy generated by the expansion of a given weight of steam depends upon the number of times the steam is expanded and not upon the particular pressures between which it is expanded, or, in other words, one pound of steam expanded from 4″ to 2 absolute pressure (26″ to a 28″ vacuum) at atmospheric pressure of 30″ of mercury or from 2 pounds to 1 pound absolute, is capable of as much work as expanding the same pound of steam from 150 pounds to 75 pounds pressure. This is very clearly illustrated in diagrammatical form in an article written and published in "Power", October 9th, 1905, by its editor, Mr. FRED R. LOW.

Without expansion, steam is incapable of motion, but other things being equal its motion is in accordance with its expansion, that is, its acceleration is increased as the difference in pressures between which it is expanded is increased.

In the Curtis turbine the steam is expanded in a series of expanding nozzles so designed that it will expand it between such pressures as will give to the steam the desired velocity and to which we shall refer more in detail later.

For the present let us consider two facts.

First: That steam expanded from 150 pounds pressure to that of the atmosphere will acquire a velocity of 2,950 feet per second.

Second: That in order to efficiently utilize this velocity it is necessary that the actuated medium (the buckets) move at a speed one-half that of the steam actuating them. Therefore, in this case, the bucket speed to meet these conditions must be 1,475 feet per second. Let us consider these buckets milled on the periphery of a wheel one foot in diameter and it will at once become apparent that this wheel must rotate at a speed equal to a circumferential speed of 1,475 feet per second, which would result in a shaft speed of $\frac{1{,}475 \times 60}{3.1416} = 2{,}8170.3$ revolutions per minute.

It is obvious from the foregoing that a means must be devised whereby we shall be enabled to overcome this excessive speed. In order to arrive at a solution of this problem in proper sequence let us more fully investigate the interaction of the buckets and steam and their effect on each other.

The shape of the Curtis bucket may best be compared to a vertical new moon, so arranged that the steam is brought in contact with it at the top, at an angle corresponding closely to the arc of the buckets. When the flowing steam is brought in contact with the buckets, which due to their shape tend to change its direction of flow, it tends to move these buckets.

Neglecting losses the velocity of the steam on leaving the bucket equals the velocity at which it enters it.

If the bucket is in motion the nozzle delivering the steam being stationary, the velocity of the steam leaving the bucket will, instead of equalling the entrance velocity, equal the difference between the bucket velocity and the entrance velocity. That is, the steam in travelling faster than the bucket, and following around the curve of the bucket, leaves it with a velocity relative to the bucket, the same as that at which it entered.

Mr. J. G. CALLAN of Lynn, gave an explanation of this in a recent lecture which describes this action most clearly: "Steam enters the bucket at velocity (V_1) follows the arc of the bucket and neglecting losses, the velocity which is left is (V_2).

The weight of the steam has remained unchanged and since the energy of a moving body is one-half the mass, times its veloc-

ity squared, the energy possessed by the steam as it goes into the bucket is $(\frac{MV_1}{2})^2$. Its energy as it comes out is $(\frac{MV_2}{2})^2$ and the energy given up to the bucket is $(\frac{MV_1}{2})^2 - (\frac{MV_2}{2})^2$.

This has been given up to the buckets because the steam was pushing while the buckets were moving.

If the buckets had been stationary it would have simply changed the direction of the steam without material loss of energy, as it would have entered at a velocity of V_1 and left it at practically the same velocity.

Do not understand that the steam would not tend to actuate the stationary bucket, for it would, for the pressure on the bucket is greater when the bucket is stationary and is reduced as the bucket moves away from the steam, as the steam pushes the bucket under these conditions with the lessened velocity.

If the bucket is held stationary no work is being done. Work is represented by the formula $(\frac{MV}{2})^2$ also by F. S. or force multiplied by space.

If force acted upon the bucket without moving it, no work would be done. The steam delivered by the nozzle is moving so fast that it is not at all inconvenienced in keeping up its push on buckets moving at a high speed, and as we increase the velocity of the bucket the steam is able to follow it and tends to push it forward up to a velocity equal to that of itself; if the speed of the bucket reaches that of the steam the steam would simply follow it without pushing at all. Bear in mind that it is the proportion of the volume of the steam to the resistance to the movement of the bucket which determines the speed of the bucket.

From the foregoing it is easy to determine the best speed conditions. When the bucket is stationary the push is greatest and its velocity is zero and when the speed of both the steam and the bucket are equal the velocity is greatest and the push is zero; at both these extremes the work done is zero.

There is a point between these two extremes where the effect

will be maximum. That point will be where the energy remaining in the steam after it has passed through the bucket will be the least.

Now let us assume that V_1 is just twice the velocity of the bucket, then subtracting this bucket velocity from the steam velocity, leaving the remainder as the speed of overtaking, and then substract the same bucket velocity from it again and we shall have subtracted the half of V, twice and V_2 will become zero; in other words, with the bucket moving at one-half the speed of the steam which actuates it the velocity remaining in the steam is zero and it is clear that we have obtained maximum efficiency."

But as previously stated, we are in trouble due to the excessive shaft-speed resulting from the bucket speed necessary to maintain these conditions. There are two methods by which we can reduce our shaft-speed without resorting to gears. *First:* We can cause the steam to acquire its full velocity, cause it to actuate the buckets of the first moving wheel and give up a certain amount of velocity, then pass it through stationary re-directing blades and cause it to actuate the buckets of a second wheel and give up to it more of its velocity and pass it on by the same method to a third and even a fourth wheel.

Another method is to utilize during the first step part of the energy of the steam for acceleration, that is to say, expand it from boiler pressure, to say one-half or one-quarter of the exhaust pressure.

It is obvious that by this method we have transformed only a part of the potential energy of the steam into kinetic energy and by so doing have caused the steam to move at a proportionately lower speed.

We may now expand it further by as many steps as are found to be desirable. Either of the foregoing methods will result in enabling us to reduce our shaft speed. Considering the second method, suppose we take a four-stage turbine compared with a single stage, with one wheel per stage in each. It would appear at first glance that by the use of four stages we should reduce

our shaft speed in the ratio of four to one, but this would not be the case. The steam admitted to each of the four stages will have one-quarter of the total energy, equal to one-half of the steam velocity, which would result, if all the energy were used to produce velocity in one stage. Now the economical wheel must move at a peripheral speed which is proportional to the velocity and not the energy, of the steam which actuates it and as the steam velocity has only been halved by using four stages, we have only reduced our shaft speed by a like amount, assuming a single wheel per stage.

Therefore, by this method shaft speed is reduced as the square root of the number of stages used.

Let us now investigate the first method of reducing shaft speed. If, as before stated, we expand the steam completely in the nozzle and obtain full velocity, and actuate but one wheel with it, the wheel must move at a peripheral speed equal to about one-half of the velocity of the steam, in order to produce the best results. Now if we can devise a means by which we can re-direct the steam as it emerges from this wheel and bring it in contact with a second wheel, this second wheel moving at the same speed and in the same direction as the first, will extract practically the same amount of velocity from the steam, so each of the two wheels need have but half the peripheral velocity of the single wheel. Therefore by the use of two wheels, we reduce the shaft speed to one-half. Now let us combine the two methods and note the result.

Let us expand our steam from boiler pressure in a set of admission nozzles to, say, within three-quarters of exhaust pressure and with it actuate the buckets of a first moving wheel, where it will give up a certain amount of velocity, then pass it through a set of stationary re-directing blades, and cause it to actuate the buckets of a second wheel which shall abstract the balance of its velocity. After leaving this second wheel the kinetic energy of the steam is exhausted but it still possesses potential energy, from the fact that it is capable of further expansion.

We have now passed what is termed the first stage. Let us now deliver the steam to a second set of expanding nozzles which will permit it to expand to within one-half of the exhaust pressure, thus giving velocity to the steam equal to the first expansion, and deliver it to two similar wheels and set of re-directing vanes where the same process is repeated, resulting in the velocity being reduced to zero and the steam brought to rest.

We have now passed what is termed the second stage, but the steam still possesses potential energy, being capable of further expansion.

We now deliver it to a third set of nozzles which expand it to within one-quarter of exhaust pressure, thus producing a steam velocity equal to each of the previous expansions and deliver it to two more wheels and set of re-directing vanes, with the same result, passing now what is termed the third stage.

Here we deliver the steam to a fourth set of nozzles which expand it to exhaust pressure, again imparting to it a velocity equal to what it possessed on entering each of the three previous stages, which velocity is abstracted in a similar manner by two more wheels and set of re-directing vanes. We have now passed what is termed the fourth stage, and have abstracted from the steam all of its energy. Now let us see what we have accomplished.

Our bucket speed is, in each case, half our steam speed and we have halved this twice, first by doubling our number of wheels per stage and second by increasing the number of stages. This has resulted in a very comfortable bucket speed and, due to the diameter of the wheels, we are enabled to use with this design, a very reasonable shaft speed.

The foregoing are some of the conditions of which advantage is taken in the design of the Curtis turbine and the steam conditions described are practically those existing in the latest type of this machine in capacities from and including 500 K.W. to and including 8,000 K. W.

Allow me to here state that the Curtis turbine permits of the

development of machines of any capacity which commercial conditions would make desirable, from the smallest to the largest, without in any way handicapping its design, which desirable conditions do not exist in connection with any other steam turbine at present known.

It is extremely doubtful, however, if Curtis turbines much larger than 8,000 K. W. will be developed for the reason that transportation facilities for larger machines are inadequate, in fact the manufacturers are obliged now to build and maintain special cars on which to transport 5,000 and 8,000 K. W. Curtis turbines. Let us now examine with some care the different items which combined constitute the completed machine, considering them in order as far as possible.

SCREEN.

A screen is provided in the main supply pipe, to prevent the possibility of scale or other foreign matter from entering the turbine.

MAIN ADMISSION VALVE.

There is nothing particularly novel about this item except that when the turbine is in operation it is fully open and may be automatically closed by what is termed an

EMERGENCY STOP.

This consists of a steel ring, surrounding the shaft just under the middle steady bearing, heavier on one side, and held concentric to the shaft by an adjustable spring on the opposite side, which can be so adjusted that at any predetermined speed above the normal, the weight of the ring will overcome the tension of the spring, due to centrifugal force, and becoming eccentric to the shaft, strike a trip wing which springs a catch supporting a weight. This weight, raised by a chain and held aloft over the main throttle valve, is set so that the instant the catch is sprung, the weight falls on a pair of toggle joints, releasing the throttle valve, forcibly shutting it and thus stopping admission of steam to the turbine; the catch may also be sprung by hand.

GOVERNOR.

The governor is of the spring loaded fly-ball type, actuated by the main shaft of which it is a part, being an extension of the same and necessarily operating at the same speed, without the introduction of intermediaries. The movement of this governor actuates the device controlling the valves admitting the steam to the turbine. On the governor hood of such machines as make its use desirable, is located a small motor enabling the operator to control the tension of the governor spring from the switch-board, thereby enabling him easily to adjust the speed of the turbine for the purpose of synchronizing it with other machines.

ADMISSION VALVES.

Steam is admitted to the turbine proper by a series of valves, varying in number in accordance with the capacity of the machine.

These valves are arranged to open successively and are of such number and size that with two-thirds of the valves open the turbine will operate at full load.

The action of these valves is such, that all working valves are fully open and all idle valves are tightly closed with one exception which will be explained later. This obviates the possibility of any steam throttling, or steam hammer liable to cause undue stress on the piping or boilers. The operation of these admission valves is controlled by the governor by three different methods.

ELECTRICAL CONTROL.

A suitable rod from the governor rotates a cylinder on which are located contacts corresponding in number to the number of admission valves to be operated. These contacts are so located on the cylinder as to engage successively. Each contact is electrically connected with a solenoid operated by approximately one-half ampere of current, delivered from the exciter or other convenient source.

Each solenoid operates a small pilot valve, each of which

actuates a main admission valve. These main admission valves are a simple form of poppet valve actuated by unbalanced steam pressure regulated by the pilot valves.

MECHANICAL CONTROL.

A gear is located on the main shaft which engages with a suitable pinion secured to an auxiliary shaft, and which by the aid of a suitable crank delivers reciprocating motion to a series of dogs or latches which engage successively a series of cams, whose relation to the latches is determined by a rod connected to the governor arm, which mechanism successively operates the admission valves.

By this method the valves are mechanically opened and closed.

HYDRAULIC CONTROL.

With this control, a rod rigging connects the governor and the piston rod of a hydraulic cylinder. One link in the rigging is a horizontal cross-arm supported at one end by the rod rigging on the governor side, and at the other end by a connecting rod from the piston, while at the centre of the cross-arm the stem of a small controlling valve is trunnioned.

This valve is operated by the governor and controls the admission of oil to the hydraulic cylinder, while a differential action supplied to the cross-arm (referred to above) by the piston rod, allows the controlling valve to operate across its central position for any position of the governor (and therefore for all speed and load conditions) so that the main operating piston, and thus the number of open valves, will be fixed for any given speed of the turbine.

This prevents hunting and allows an exceedingly fine adjustment of regulation. By means of a piston rod, the hydraulic cylinder, situated in the generator stool, turns a cylinder on which cams are set to successively operate the levers that in turn raise or lower the piston valves. In this way all valves actually supplying the steam to the turbine are open wide and

working at full efficiency, with the exception of the last valve opened, which throttles the steam admitted through it, accordingly as the governor and hydraulic cylinder allow.

STEAM CHEST.

The admission valves are located in a steam chest, or in the case of the larger sizes of turbines in two steam chests located on top of the first or high pressure stage and on the outer periphery.

If two steam chests are provided they are located at points diametrically opposite and are piped directly to the main admission valve.

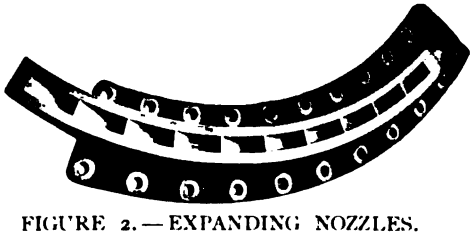


FIGURE 2.—EXPANDING NOZZLES.

EXPANDING NOZZLES.

The first stage expanding nozzles which deliver the steam to the first stage buckets are of a number corresponding to the number of admission valves, each nozzle being controlled by its own individual valve. They are of such dimensions that the steam will expand from gauge pressure to the predetermined pressure necessary to give to the steam the desired velocity, and of such shape and pitch as will deliver the steam directly into the buckets without any abrupt change in direction and without shock, in other words, at an angle corresponding closely to the arc of the buckets. As has already been explained these nozzles become active successively and their delivery ends are brought so closely together that the admitted steam is delivered to the buckets in an unbroken continuous belt of a length proportionate to the load on the turbine and of a width corresponding to the length of the buckets.

It is obvious that regulation is accomplished by lengthening or shortening this belt of admitted steam, which, under full load conditions approximately encircles one-sixth of the circumference of the first stage.

After the steam has given up its velocity to the first stage buckets it is by them delivered to a row of nozzles, in which it expands to the second stage pressure, similar to the first stage nozzles except that they are uncontrolled and prepared at all times to expand all the steam delivered to them by the first stage wheels. They are larger and there are more of them extending around approximately one-third of the circumference, for the reason that the partially expanded steam now occupies more area.

The second stage wheels deliver the steam to a third line of expanding nozzles, still larger and extending around approximately one-half the circumference, which expands it to third stage pressure and the third stage wheels deliver it to the fourth stage nozzles, which are still larger in size and which encircle almost the entire circumference due to the increased area occupied by the steam due to its expansion.

It will be noted that from the point of delivery by the first stage nozzles the flow of the steam through the turbine is continuous, thus causing no undue stress on any of its parts, that there are no sudden and frequent temperature changes to result in thermal losses.

I would also call particular attention to the fact that these expanding nozzles are in no way adjustable and that the resulting expansion is fixed, that their efficiency is dependent wholly on design and in no way dependent on adjustment.

BUCKETS.

The buckets are cut by special machinery, in some cases from the periphery of the wheel of steel casting, in others in the outer circumference of a ring of steel casting, the outer diameter of which corresponds to the diameter of the wheel to which it is ultimately to be secured and for use in the turbines of larger

FIGURE 3.—CURTIS TURBINE BUCKETS.

capacity the buckets are milled from sections of cast bronze some two feet long and containing, when completed, according to the dimensions of the buckets, from 15 to 24 buckets each.

In any event, the finished buckets are less in width than the material from which they are formed, and their width is from one-half to three-quarters of their length and the thickness at their centres is approximately equal to one quarter of their length.

Surrounding the outer ends of the buckets is a metal shrouding to which the end of each individual bucket is securely riveted. The shape of the bucket is straight in a radial direction and curved in an axial direction or, as previously mentioned, corresponds in a way to a vertical new moon.

Experience has demonstrated the fact that either bronze or steel present no particular advantage each over the other so far as operation is concerned and the selection of either metal for buckets is determined by manufacturing conditions only.

The dimensions of the buckets necessarily vary with the size of the machine and also in the several stages in which they are to operate and notwithstanding the fact that due to the comparatively low bucket speed, the bucket strains are considerably less than in other types of turbines, the bucket construction is in every way more substantial and rugged.

The following diagram will enable me to call to your notice more clearly some of the characteristics in connection with the shape of the buckets.

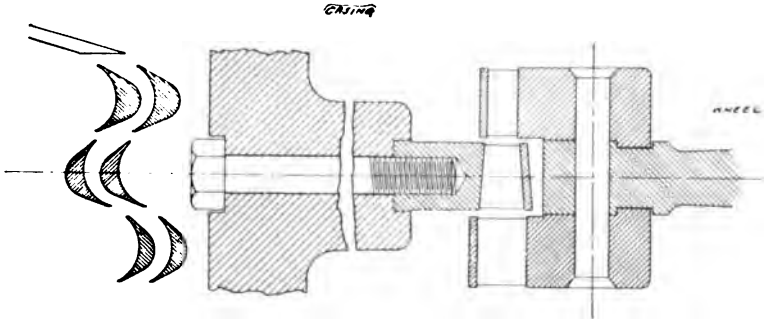


FIGURE 4.—SECTION THROUGH BUCKETS.

At the upper left hand corner is represented the expanding nozzle delivering the steam to the buckets and expanding it from gauge pressure which enables the steam to acquire the desired velocity.

It will be noticed that the angle of delivery corresponds closely to the arc of the buckets which the steam will easily enter without shock, excessive friction, or sharp angular deflection.

On leaving the nozzle the steam is delivered into the space between the first row of moving buckets which are constructed in sections and firmly riveted to the upper side of the supporting wheel.

On entering this first row of moving buckets, part of the velocity of the steam is transferred to them and by their curvature the direction of the flow of the steam is changed and is by them delivered to the row of stationary re-directing buckets termed "intermediates," where its direction is again changed without shock and also, as previously explained, without diminution of velocity or energy and is by them delivered to the second row of moving buckets similar to the first, to which the balance of the velocity of the steam is imparted.

This second row of moving buckets is riveted to the under side of the same wheel to the top-side of which the first row of moving buckets is secured.

This method gives the same effect as using two wheels and is much to be preferred.

I will here call your attention to one or two features which may be of interest.

You will notice that the path provided for the steam is a gradual curve, presenting no sharp or sudden changes of direction.

That its path gradually increases in area as the velocity is being abstracted during its travel.

You will notice that the distance between the centre of the buckets is less than between tips, the reason for this being that with steam traveling at a high velocity, on making the turn at the bucket center, there is a compression of the steam which if this area were equal at all points would result in effecting a partial vacuum on the front centre of the bucket.

Eddy currents would develop in the steam and a portion would change its direction of flow and be drawn into this vacuum, run back into the incoming jet, thus impairing the efficiency.

For this reason, while the expansion of the steam is in no way dependent on the area between buckets, for which reason, inequalities at this point are of less vital importance than in some turbines, it is still a matter worthy of very careful design to proportion this area exactly in accordance with the compression and still not contract the area to the extent of introducing friction which would be so objectionable.

The short, sturdy bucket design with all buckets positively secured at all points preventing the remotest possibility for the buckets changing position with relation to each other, is one of the strongest factors of its success. And here again is brought prominently to our notice that these conditions are wholly a matter of design and the results are in no way dependent on adjustment.

It will be noticed that the angle of entrance and angle of departure of the steam to and from all buckets is equal or, in other words, the position of all buckets is symmetrical with respect to the axis of rotation, hence there is absolutely no end thrust or torsional strain on any of the buckets.

It will also be noted from the diagram that the finished

bucket being less in width than the material from which it is formed, and the shrouding being of a width equal to the bucket material, absolutely prohibits the buckets from coming in contact with anything other than the actuating medium, under any condition of operation.

This may, perhaps, be more strongly emphasized by the fact that in all the Curtis turbines in operation, there has never been a bucket injured, except by solid foreign matter which has entered with the steam.

In the bucket construction more than any where else is evidenced the fact that the high efficiency is dependent on rugged design, for while the bucket which transmits the energy is the smallest member and in the Curtis turbine it is the most sturdily constructed part and the one most thoroughly protected.

INTERMEDIATES.

As will be seen from the previous diagram the intermediates or stationary buckets are exact counter parts of the moving vanes, in so far as their dimensions and shape are concerned and are made in sections of approximately the same length but as they are securely bolted to the inner circumference of the turbine shell, with the bucket arc in the reverse direction to the arc of the moving buckets, they radiate towards the centre instead of from it.

These intermediates are of the same sturdy construction as the buckets, and like them being secured at either end, it is impossible for them to change position either with relation to each other or in their relation to the buckets.

Here again proper functioning is wholly dependent on design and in no way dependent on adjustment.

As previously stated the active steam does not surround the entire circumference of the machine and for this reason, neither do the intermediates, for as their province is only to re-direct the steam it is only necessary to locate them around such part of the circumference as is traversed by the active steam.

SHELL.

The stationary element or casing consists of a circular cast iron exhaust chamber of ample proportions to provide sufficient area for the discharge of any medium which can be admitted through the turbine and of such height as will make absolutely prohibitive the possibility under any conditions of back water from the condenser in any way interfering with the proper operation of the moving parts.

To this exhaust base is securely bolted, around its entire circumference, the cast iron turbine casing which is perpendicularly divided into two or more segments, and horizontally into two or more sections, according to the capacity of the turbine, thus making all parts of the interior easy of access.

The casing or shell is cylindrical in form and throughout of practically uniform diameter. From the fact that active steam does not come in contact with the shell, also from the fact that the pressure of the atmosphere on the interior does not vary widely from that of the atmosphere surrounding it, no special provisions are necessary for packing the joints of the shell. As neither the steam or the exhaust piping are in contact with the casing at any point, it is unnecessary to disturb any of the piping in order readily to reach the interior.

No joints being packed, steam admitted at extremely high temperature is in no way detrimental to the machine. Diameters being uniform and temperatures constant there is no tendency towards unequal expansion of metal resulting in warping or distortion.

WHEELS.

The wheels designed to support the moving buckets in their proper position and transfer the energy received by them to the shaft, are formed from solid steel castings of such dimensions as will insure their rigidity under all conditions of load. They are securely keyed to the shaft at the hub which is of a length corresponding to the length of the stage in which it operates. From the hub the wheel gradually tapers to its periphery, where

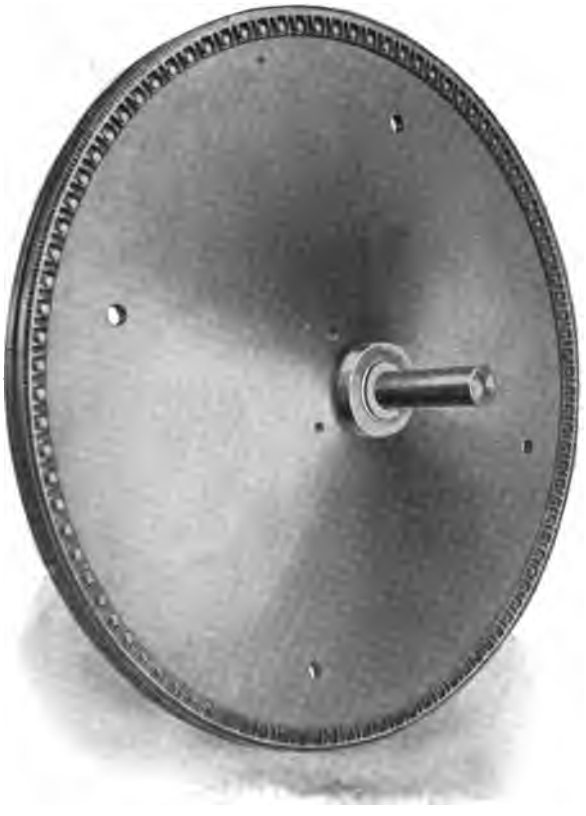


FIGURE 5. — REVOLVING WHEEL FOR 2,000 KW. CURTIS STEAM TURBINE.

its thickness is according to the capacity of the turbine in which it is used from 1 inch to 1½ inches.

The diameter being such as may be determined by the shaft and bucket speed.

There is one of these wheels for supporting the two rows of moving buckets in each stage of the turbine.

A channel is turned on each side of the wheel approximately 2 inches from its periphery.

By reference to diagram No. 4, it will be noted that this

channel is for the reception of a corresponding shoulder on the bucket segments, which are securely riveted to each side of the wheel through suitable holes drilled in the wheel for the purpose. This channel and shoulder take care of all centrifugal strains so that the only province of the rivets is to support the weight of the bucket segment.

Professor A. RATEAU of Paris, France, on page 7, of a paper read by him May, 1904, before the American Society of Mechanical Engineers in discussing the Curtis turbine says:—

"The type which we have described as having a group of wheels possesses the notable advantage of allowing a great reduction in speed of rotation for wheels of the same diameter and the same number.

"It would, therefore, be preferred to all others if it had not, in our opinion, the grave defect of preventing a sufficiently high efficiency being attained."

Under the head of Efficiency, I will submit for your consideration some facts and figures with regard to efficiencies obtained under commercial operating conditions which would, undoubtedly, change his opinion on the efficiency question.

SHAFT.

The shaft is constructed of rolled steel, designed to operate in a vertical position when applied to machines of 500 K. W. capacity and over.

It is of such diameter as will comfortably handle the torsional strains and support the weight, there being no possibility of serious results, if the shaft should spring, nor from its position can there be any tendency to spring.

At this point I cannot refrain from quoting one of the members of this Association, who is one of our most prominent engineers. In discussing the vertical shaft he referred to it as follows:

"There can be no question but that the vertical shaft is the ideal form of steam turbine, as in mechanics the best products are vertical, viz: — the vertical boiler, vertical engine, and the

vertical shaft turbine, so in nature the Almighty made his best product — Man — vertical."

The reasons for the adoption of this vertical shaft can, I feel, be better given under the next subject.

BEARINGS.

Up to this point we have not dwelt upon any part of the turbine where it has been necessary to consider friction, as we have, as yet, brought no moving member into contact with any stationary part.

In all sizes from 500 to 8,000 K. W., there is but one working bearing, located at the lower end of the shaft, which is fitted with a key-way as well as two dowel holes. A circular

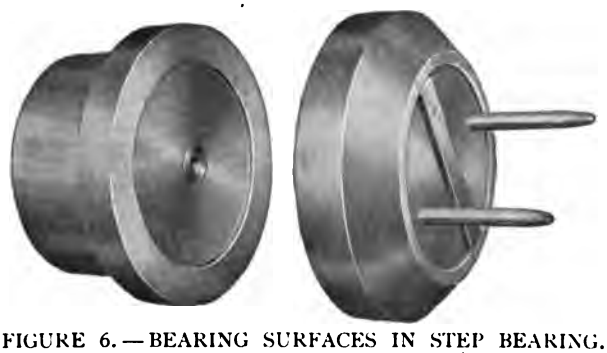


FIGURE 6. — BEARING SURFACES IN STEP BEARING.

block of chilled cast iron is provided with a key and two dowels fitted to its upper surface. This block is fitted to the bottom of the shaft and rotates with it. The under surface of this block is smooth. A corresponding cast iron block, having a smooth upper surface is opposed to this upper block, having a hole through its centre into which is threaded a pipe for supplying the lubricant which is forced between the blocks at a pressure sufficient to support the weight of the moving member.

The pressure at which the lubricant is supplied is, of course, determined by the weight to be supported and the area of the supporting step blocks.

The step pressures used in commercial practice vary from 180 pounds in the 500 KW. to 450 pounds in the 8,000 KW. Either oil or water may be used for lubricating this bearing. If water is used it is generally taken from the hot-well by the step pump and forced between the blocks, should the pressure rise it tends to force the blocks further apart. This increases the opportunity for the lubricant to escape, on the other hand, should the pressure fall, the space between the blocks is lessened and the pressure will increase.

After passing through the step, the water escapes upward around the shaft into the exhaust base of the turbine where it mingles with the exhaust steam passing through the condenser, again returning to the hot well.

There being no metallic friction in this bearing the temperature of the lubricant is of little moment, so long as it does not reach a temperature of vaporization in the case of water or carbonization in the case of oil.

When oil is used for lubricating the step, the bearing is located below and outside the exhaust base, and, after passing through the bearing, the oil returns to the tank from which it was pumped.

There are some 500 of these bearings in successful commercial operation, more than half of which have been in continuous service over two years.

The National Electric Light Association appointed a committee to investigate steam turbines and the following is copied from page 62 of the report of this committee, submitted to the Association May, 1904.

" In regard to the operation of the step bearing of the Curtis turbine, there has been no objection from users, and we have been unable to locate a case in which it has given trouble. We did not receive any unfavorable replies from the users regarding the operation of the turbine or any of its parts."

The replies to which reference is made were in response to a letter which the committee addressed to every turbine user in this country.

The same committee was retained and on page 15 of their 1905 report they say: "We have been unable to find a single case where the step bearing has given any serious trouble."

In their 1906 report they made no mention of the step-bearing other than to note some minor changes, thereby evidencing the fact that it had ceased to be a matter of unusual concern.

At the suggestion of a member of the committee, that in view of the fact that the turbine had proven itself beyond question a desirable prime mover and so generally accepted, he felt that the Association had no further use for the committee. The Association agreed with him, thanked the committee and discharged it.

Quoting from a paper read by J. A. RADFORD before the Association of Edison Illuminating Companies, September, 1905, he says

"The step bearing feature of the vertical turbine has, in my opinion, with two years' experience, proved to be a most satisfactory and rugged piece of machinery.

I well remember the visions I had of what might occur should the supply of oil fail with the turbine in operation, especially since the machines that I was to operate, had only one source of oil supply and that from a motor driven triplex power pump for each machine.

At the time we were operating with only the pumps above mentioned, which was before the high pressure oil system was completed, two turbines were in operation carrying only about 3,000 K. W. each, during the noon hour, when the motor armature on the second turbine oil pump burned out without warning and in very few minutes came to stand-still.

The load on the turbine was quickly transferred, but not before what was considered serious damage had been done to the step bearing.

The burned motor armature was immediately replaced, and preparations made to install a new set of step bearing blocks which were on hand.

Before starting to remove the step blocks, however, it was

decided to get the oil pump in operation and try the turbine. The oil pump was started again and oil pressure put on the step bearing.

The pressure indicated on the guage, however, was only 750 pounds, where it had formerly been 900 pounds. This, of course, indicated that the step blocks had at least been somewhat scored.

The next test applied was the usual method of ascertaining if the machine would freely revolve, and accordingly a man was sent to the top of the generator to lift one of the cast-iron grids and brace his feet against one pole of the revolting field, to see if the machine would turn freely. Everything was found correct in this respect and the turbine was placed in regular service. About two weeks later when the step bearing was removed for the purpose of ascertaining its condition, the blocks were, of course, found in a rough scored state and certainly did not appear anything like the carefully hand scraped surfaces that had at first been prepared.

The blocks were refaced in a lathe, carefully scraped and put in place. To our surprise, when the turbine was again started, the vibration was so severe that it was not considered safe to bring it up to normal speed. We again removed the step blocks for careful examination expecting to find something wrong, but did not know just what. No imperfections were found, everything checked satisfactory and the bearing was replaced. The machine started but the vibration was as bad as ever.

After carefully thinking the matter over I asked the erecting engineer if he would object to grinding the surfaces of the step block together by shutting off the oil supply for a moment, with the turbine revolving at about twenty or thirty revolutions per minute.

My argument was that the step blocks and shaft were not in perfect alignment and that if they were allowed to rotate without oil for a few revolutions they would certainly set squarely one upon the other.

Moreover I argued that since the bearing blocks had done

such good service in the past two weeks, badly scored as they were, no possible harm could result from a trial of this scheme.

After arguing, pro and con, we finally agreed to apply this awful remedy, shutting off the oil supply on a step bearing with the turbine in motion. When the oil was first stopped it was not restored again until sounds could be heard emanating from the vicinity of the step, which indicated that there was "something doing."

With the oil on again, the turbine was immediately brought up to speed, and the improvement in the vibration was very noticeable, in fact, we were so encouraged with the result that the machine was put through the same course of treatment four or five times, until finally it ran at normal speed without the slightest tremor. From an operating stand-point I would much prefer a vertical machine with a step bearing, over any arrangement of horizontal shaft bearing since in the event of any serious trouble, injury to the shaft is very likely to occur on a horizontal shaft even with babbitt lined bearings.

With the step bearing it is quite different.

In case of injury the worse that can occur would be the complete ruin of the step blocks which can be replaced at a comparatively slight expense and when renewed all trace of trouble disappears."

The turbines referred to in the foregoing are of 5,000 K. W. normal capacity in which the moving member weighs approximately 146,000 pounds.

Allow me to quote from a letter received from Mr. R. L. ALLEN, Manager of the Economy Light and Power Company of Joliet, Ill., under date of January 23rd, 1905, he says: "As to the step bearing, I have never had any apprehension, and I think that if it were not for the criticism of this feature of the Curtis turbine by manufacturers of other types of turbines, that this point would not be made so prominent.

As a matter of fact, our experience, which is similar to that of other users, proves the reliability of this part of the machine and while your company has put "all of its eggs in one basket"

I consider that they have been put in the sort of a basket that insures their safety, which in my judgment is much better than dividing them into several baskets of lesser safety.

I think the criticism of your step-bearing is due largely to inexperience and unfamiliarity with it in operation. I wish we could feel as secure from trouble with the lignum vitae steps in our water power plant as we do from the step bearing on the turbine."

Let us discuss this vertical construction, and allow me to present for your consideration some of the conditions which are responsible for its adoption and I will then leave it to you to decide whether its designers were wise or foolish.

Allow me first to state that the design of the Curtis turbine is such that it is better adapted for horizontal operation than any other turbine at present manufactured either in this country or abroad, and for the following reasons:

1st. The rotative speed is less than that of any other design and with the same diameter of shaft the surface speed of the shaft in the bearings would be correspondingly lower.

2nd. The weight of the moving member is no more than that of other turbines and much less than most, size for size, consequently the shaft diameter required is less than most and no greater than any.

3rd. There is no end thrust from the fact that the steam enters and leaves the bucket at the same angle.

4th. The steam travel from admission to exhaust is very short resulting in a length of steam unit one quarter the length of most and one-sixth of the length of many, size for size.

As the bearings must be located outside the steam space it is obvious that the length of the unsupported shaft, carrying weight, between bearings, is correspondingly shorter and consequently stiffer, again admitting of the use of shaft of smaller cross-section.

5th. Due to the design of the Curtis turbine clearances in a radical direction are of no importance, consequently a space is left between the ends of the buckets and the shell from two to four inches, according to the size of the machine.

If it were operated in horizontal bearings and bearing trouble developed to the extent of dropping the rotor it could not drop far enough to injure any of the body part of the machine, which is the case with no other turbine.

6th. All turbines are or should be designed for the use of high temperature steam. We all know that the expansion of metal is in direct proportion to its volume and the temperature changes to which it is subjected. We also know that a horizontal steam turbine must have a shaft packing at each end. These conditions present problems of no small importance.

The length of shaft in the Curtis turbine in contact with high temperature is, as before stated, one-quarter the length of most and one-sixth the length of many. In fact, advantage of these particularly attractive conditions have been taken in the manufacture of the Curtis turbine in the smaller sizes. The 15-20-25-35-50-75-100-150-300 KW. Curtis turbines are all designed as horizontal machines and it may interest you to know that there have been a larger number of horizontal shaft Curtis turbines sold to date than those of any other manufacturer of horizontal turbines in this country, and it is quite probable that further advantage may be taken of these conditions in the development of some of the larger direct current turbines, which form of construction it may be, will present other advantages when considered in connection with the comparatively long commutator which it is found desirable to use in connection with this form of generator, due to the high peripheral speed which would result from the use of a commutator of ordinary design.

It will, therefore, be noted that while everything in connection with the design of the Curtis turbine better fits it for horizontal operation than does the design of any other turbine at present on the market, the vertical design was selected for the Curtis turbines of the larger size alternating current machines.

To bring more prominently to your notice the conditions existing in this connection, allow me to quote from a paper read by W. J. A. LONDON, engineer of the British Westinghouse Com-

pany, read before The University, Manchester, England, February 28th, 1905.

Referring to horizontal bearings he says:

"In turbine bearings we are confronted with the following conflicting conditions. On the one hand, the shaft should be sufficiently strong and rigid, necessitating journals of large diameters,and the bearings must be sufficiently long to keep the pressure per square inch low, to allow of the oil being constantly renewed around the journal. One the other hand, the circumferential speed of the journal must be kept as low as possible to reduce friction.

In order to make the whole length of the bearing effective this length must not be excessive."

The designers of the Curtis turbine, appreciating the conditions mentioned by Mr. LONDON, felt that by the adoption of the vertical shaft for all sizes of turbines where the weight of the moving member exceeded ten thousand pounds, they would not only simplify the machine but be able practically to insure the purchase against interrupted service, reduce depreciation to a minimum, reduce the cost of repairs and up keep to the lowest point and incidentally produce a more efficient machine.

I feel that you will agree with me that their decision was a wise one for, while there are more than twice as many Curtis turbines in commercial operation in this country as there are of any other manufacture and more than twice the number of horse-power of vertical shaft turbines in operation in this country than there are of horizontal shaft turbines of all other manufacture, the bearing troubles have to the present time, been a very small fraction of one per cent.

I very much doubt if many slow speed reciprocating engine manufacturers could show you as good a record.

We are not surprised at these results, nor should you be when you consider that a vertical shaft Curtis turbine when in operaation, carrying load, is practically a top spinning on a water or oil film and that under these conditions this is the only working bearing in the machine.

There is absolutely no friction for under these conditions in no part of the machine is moving metal in contact with stationary metal.

The conditions are such that even with a 5,000 KW. machine the whole moving member, weighing approximately 146,000 pounds can be rotated by hand and on removing the load, and tripping the emergency the machine revolves two hours and a half before coming to rest.

Let us for a moment consider what the consequence would be should we by any means, lose our step pressure.

The two cast iron blocks would immediately be brought into contact and would rapidly wear away until the smooth surfaces of the wheel peripheries would be brought into contact with the material from which the intermediates are formed and this excessive friction at this wide radius plus the load on the machine would bring it to rest without other injury than making necessary the removal of the blocks at an expense of a few dollars and an interruption of service not exceeding two hours.

A screw is provided for the lower block in the event of trouble of this nature, so that it can be raised as the blocks wear, and a stoppage is by no means certain even under these conditions. A duplicate pump is always installed so the chance of even this trouble is very remote, while the interruption of lubrication on a horizontal turbine which is always furnished by a pump under pressure, would mean practically ruin to the turbine and an interruption of business of many weeks if not months.

Experiments on step bearings have shown that it takes about two minutes for blocks to wear without lubricant before it is necessary to raise the bottom block.

The writer was privileged to see a vertical shaft turbine brought to rest by friction, eight times in succession, without making it necessary to change the blocks.

In fact the method adopted for surfacing these blocks is to machine them as carefully as possible, then place them in position and rotate the machine at reduced speed without lubricant, until they present absolutely true surface.

The only other bearings are steady bearings which do no work when the machine is up to speed.

The steady bearing at the lower end of the shaft is lined with wood, and the shaft is protected by a bronze sleeve to prevent rusting on account of contact with water.

The upper steady bearing located above the generator and the middle steady bearing located between the generator and steam unit are lined with babbitt and the shaft is incased in a steel sleeve which accomplishes two purposes.

In case of accident to the bearing the steel sleeve can be removed from the shaft and a new one put in its place.

This arrangement prevents any possible serious injury to the shaft.

A plate surrounding the shaft at the top and bottom of the steady bearings encloses the sleeve mentioned, and as long as the shaft revolves, the bearings must remain full of oil on account of the pressure created by centrifugal force of the oil thrown out by the sleeve.

On account of the fact that these bearings always stand full of oil, a dash-pot effect is created which prevents possible injury to the shaft and bearings by vibration, should any develop.

These bearings are in halves for ease of access and are oil lubricated by gravity flow supplied from a reservoir located above the generator. This oil is circulated; a small pump being provided for returning it to the reservoir.

PACKED JOINTS.

The Curtis turbine has but one packed joint in the entire structure. This is located below the middle — steady bearing at the top of the steam unit, where the shaft passes through the end of the first stage. The packing consists of three graphite rings encircling the shaft; between these rings steam is admitted at boiler pressure, and discharged into one of the later stages where its energy is utilized.

The ability to simplify the packing conditions was another strong incentive for the adoption of the vertical design, which

results in making it possible to support the shaft at but one point (the bottom) leaving it absolutely free to expand upward without any possibility for pinching.

THE GENERATOR.

Many people, without carefully considering the matter, fail to appreciate the conditions which make practically prohibitive the application of the mechanical output of the steam turbine other than through the agency of the electrical generator.

Let us open the consideration of this phase of the subject with a full understanding of the fact that the Curtis turbine operates at a rotative speed of one-half that of any other turbine on the market in this country and is, therefore, that much better adapted for mechanical operation.

The Curtis turbine which operates at the slowest shaft speed is of 8,000 K. W. normal capacity and capable of an output of 12,000 K. W. The maximum available output of the steam unit is therefore approximately 18,000 H. P. The shaft speed at which this unit operates is 720 revolutions per minute.

Let us assume a belt speed of 5,000 feet per minute to transmit this energy, with a view to determining the diameter of a pulley suitable to deliver this power $\frac{5000 \times 12}{3.1416 \times 720} = 26.5$ diameter and I will leave it to the reader to figure the face of the pulley necessary to transmit the 18,000 H. P. either by belt or ropes.

I do not think it necessary to pursue the investigation further in this line as you at once appreciate the fact that it is only through the agency of the electric generator that the energy of the turbine of today can be made applicable.

Alternating current generators are almost universally employed for this purpose as the rotative speed of the turbine is so high as to result in a peripheral speed of the commutator which makes its use prohibitive with any other type of turbine except the Curtis for which reason the Curtis is the only turbine with which is supplied a direct current generator directly

connected to and operating at the same speed as the turbine shaft, the alternating current generator being more flexible in its adaptation, its use predominates.

The generator designed for use with the Curtis turbine operates at a speed which not only allows of successful commutation but presents almost perfect characteristics of generator design for either direct or alternating current, to the end that the generators designed by the manufacturers for use in connection with the Curtis turbine present both mechanical and electrical characteristics, which are unsurpassed by any line of generators ever offered for commercial service by any manufacturer.

ROTOR.

The general scheme of ventilation is to arrange the air circulation so that the movement of the air will be definite, and will not consist in "churning" the same air over and over. In order to accomplish this definite movement, the air is for the most part drawn in through openings at the top and as near the shaft as the guide bearing will permit.

The stationary part of the alternating current machines is the armature and, consequently, is that part built up of laminations where the hysteretic losses and, consequently, by this laminated structure or core, is the seat of the generation of heat.

It is built up in sections for the passage of air as it is forced out by the rotating part. The "head" or pressure to the moving air is given by the centrifugal force of the rotor.

The air is drawn into the rotor between the arms of the spider and close to the shaft and is forced out through openings in the rim. Two types of rotor are now being built, one with "definite poles" and one with construction designated as "smooth core."

The "definite pole" type of construction is employed where the number of poles is eight or more. The "smooth core" is admirably adapted for two and four pole machines.

"The "definite pole" type involves greater simplicity in the matter of field coils, there being but one coil per pole. This coil is machine wound and is rectangular.

The turns of the winding are insulated from one another and thoroughly cemented together, so that the finished coil is a solid mechanical structure.

The end projecting beyond the pole at the top and the two ends of the machine is supported against centrifugal strains either by means of strong steel straps attached to the rim underneath, or by means of strong pins above the coils passing across from the pole to a disc built up of laminations and assembled as part of the rim but outside of the ends of the field coils.

The laminated rims of some of the "definite pole" machines are built up in such a manner that simply one-half of the rim between the poles is solid.

This results in a large cross section area of air ducts. The rims of machines whose poles are relatively short in the direction parallel to the axis of rotation, do not require passage for air through the rim.

The revolving fields that involve a small number of poles, are of the "smooth core" type, with two or more field coils per pole. Some of the smaller sizes of four pole machines have these coils in parallel slots. The larger sizes of four pole machines, as well as all two pole, have the coils in radial slots.

The coils in parallel slots are wound on machines and in their shape are the same as the coils of the "definite pole" machines.

The method of assembling is similar except it is not necessary to remove any of the iron part of the rotor other than the supporting discs at the two heads and the wedges in the slots.

Nearly all "smooth core" rotors are axially constructed of definite sections with large passageways for air between the several sections.

The coils at the heads of the machine are in most designs ventilated by passageways for the air between the coils.

They are supported against centrifugal force by steel rings assembled over them and held in place by means of discs bolted to the rotor spiders or attached by means of a nut threaded to the shaft or hub of the spider.

STATOR.

The stator is what is known as the "open type" of frame construction which frame consists of a ring at each end connected by cross bars or "pillars."

The laminations of the stator core are held in place by keys that are dovetailed into these pillars.

In this machine the laminated core with the ventilating ducts and spacing blocks between sections are visible to the eye.

The air has perfect freedom in passing out into the room, while the entire outer periphery of the core where the hysteric losses originate, is exposed to the currents of air external to the machine.

The cored out holes in the ring at top and bottom serve as ventilators behind the armature winding.

RATING.

The Curtis turbine is rated in units of energy, in accordance with its available commercial output, which with a turbine (as previously explained) is and must be electricity.

The standard unit of measurement of electrical energy is the watt and one thousand watts is a kilowatt.

The medinm of operation is steam and the standard unit of measurement of steam is weight or pounds per hour.

It is impossible to get an indicator card or diagram of any steam turbine, the only equitable measure of work done by a steam turbine is the ratio which the commercial output bears to the commercial imput.

The commercial imput is steam easily measured and the commercial output is electricity also easily measured.

The Curtis turbine is, therefore, rated in kilowatt output and all guarantees made dependent on the number of pounds of steam necessary to deliver a kilowatt on the switchboard. This method eliminates all heat, steam, friction, windage, magnetic and electrical losses, in fact all losses of every name and nature pertinent to the entire unit.

We have now pretty thoroughly described the details of

the construction; let us now discuss a few of the details of operation.

STARTING.

The conditions existing in the turbine are such as call for the exercise of no excessive care in starting, as no serious trouble will develop from the admission of high pressure steam with as little delay as is permissible to insure the piping supplying the steam to the machine. Water admitted to the turbine has no more effect on it than to cause diminution of speed, for the reason (as shown) that the speed of water is less than that of steam.

There being no chance for compression in this turbine, there is no reason why, if water were delivered to it and in suitable quantity at sufficient pressure it would not run it without injurious effect.

A paper read by A. S. MANN, at the Saratoga meeting (June, 1905) of the American Society of Mechanical Engineers, gives an account of starting a 1,500 KW. Curtis turbine in forty-five seconds after it had stood for twenty-four hours.

Mr. MANN also states in the same paper that he is accustomed to start this turbine condensing, with all auxiliaries and synchronize it on the system in from 2½ to 3 minutes.

These conditions do not exist in any other turbine on the market in this country and result not only in insurance against accident but make it unnecessary to maintain the expense of keeping a spare set warmed to facilitate quick response to heavy or sudden overloads as is sometimes found desirable in large power plants.

CLEARANCES.

As has been previously stated when the Curtis turbine is in operation under full load conditions, there is no part of the machine on which the load is dependent in which moving metal in contact with stationary metal.

In fact, the only parts of the machine in which moving metal does touch stationary metal are the small governor parts and

the valves stems of light weight and where the movement is small and infrequent. The clearances between the stationary and the moving blades of the Curtis turbine are from ⅛ to ½ inches, but this is not the limiting feature, as previously explained, the width of the buckets is less than the material from which they are formed and the bands at the ends of the buckets are of the same width as this material.

The clearances between these flat smooth surface are from .06 to .70 of an inch.

The clearance between the ends of the buckets and the casing is from two to four inches according to the size of the turbine.

But, you may ask, what confines the steam to its desired path? The pressure in the stage is approximately that of the steam admitted, for which reason the steam has no tendency to change its direction of flow unless it meets an obstruction which would tend to interfere with it, and a much easier path is provided through the buckets than for it to turn sharply at right angles and leak through the clearances into a medium of its own density.

In fact, clearance between buckets of any turbine is of minor importance as far as efficiency is concerned, the principal reason for keeping them as small as good engineering will permit is to reduce the shaft length to a minimum on account of the shaft expansion.

The Curtis turbine differs, however, from most of the other turbines in that the radical clearance or the clearance between the ends of the buckets and the shell, upon which they are dependent for high efficiency are absolutely of no importance in the Curtis type.

In fact, if steam did pass through any of the earlier stages of a Curtis turbine without engaging the buckets it would still possess the kinetic energy given it by expansion and would be obliged to give it up to the buckets in the next stage.

WEAR.

From the fact as previously explained, that in no part of the

machine moving metal is in contact with stationary metal, wear from metalic friction cannot occur and the only other source from which wear could develop would be from steam friction.

While one might expect more or less wear from steam moving at a high rate of speed, when brought in contact with metal moving at a different speed, really this is not the case, as evidenced by the fact that of over four hundred turbines in use, many of which have been in for two years or more, no wear has been discovered.

ACCESSIBILITY.

In order to reach the interior of the Curtis turbine, the steam piping does not have to be disarranged in any way.

If the machine is lagged, which lagging consists of Russia iron held in place by machine screws, it is easily removed.

The removal of some twenty-five bolts, more or less, according to the size of the machine, allows the removal of from one-third to one-half of the circumference and from one-half to one-fourth of the length of the shell, thereby exposing all movable and a majority of the stationary buckets. In like manner by the removal of additional bolts, the remainder can be exposed. In doing this we have disturbed no packing of joints, nor have we been obliged to disturb the governor, admission valves, or piping, neither have we changed any adjustments, and to make the machine operative after inspection, have simply to replace the piece, or pieces removed, open the main valve and start.

Should we wish to inspect our steady bearings, they are made in halves and we simply unbolt the halves and slip them back, thereby exposing their whole interior and all sides of the shaft.

Should we wish to inspect the step, we go below the machine into a recess left in the foundation for the purpose, place a jack-screw under the step, remove a dozen bolts, more or less, and lower our jack; the whole step bearing follows the screw down and leaves the bottom of the shaft, as well as the whole step, free for inspection. Replacing is simply a reversal of the process. While the step is removed, the rotor is supported by the wheels without injury.

ADJUSTMENTS.

It is apparent from the careful study of the design and construction of the Curtis turbine that it differs to a marked degree from all other types of steam turbines in that its efficiency is in no way dependent on adjustment. In fact an improperly designed Curtis turbine can never be made to give efficient results while on the other hand if properly designed it is just as impossible to produce, with it, other than efficient results.

ATTENTION.

The attention is reduced to a minimum for the reason that no adjustments are possible and all lubrication automatic.

AUXILIARIES.

Many people have gained an idea that the auxiliaries necessary with a turbine are greater in number and require more care than with other types of prime-movers.

No more auxiliary apparatus is necessary with a vertical shaft Curtis turbine than with any horizontal turbine and the only auxiliary necessary with any steam turbine not necessary with a reciprocating engine operated under similar conditions is a pump for supplying the lubrication. If water lubrication is desired for the step instead of oil, a second pump is necessary for this purpose.

FOUNDATIONS.

The foundation necessary for the Curtis turbine is a matter of less importance than with any other steam prime mover, from the fact that there is no lateral strain or thrust, the only matter of importance in this connection is to provide a foundation of sufficient strength to support the weight. In many cases this can be more conveniently arranged with " I " beams so arranged as to support the weight, leaving the space below available for auxiliary apparatus.

In the case of the use of a masonry foundation it is customary to leave a recess in the foundation for easy access to the step.

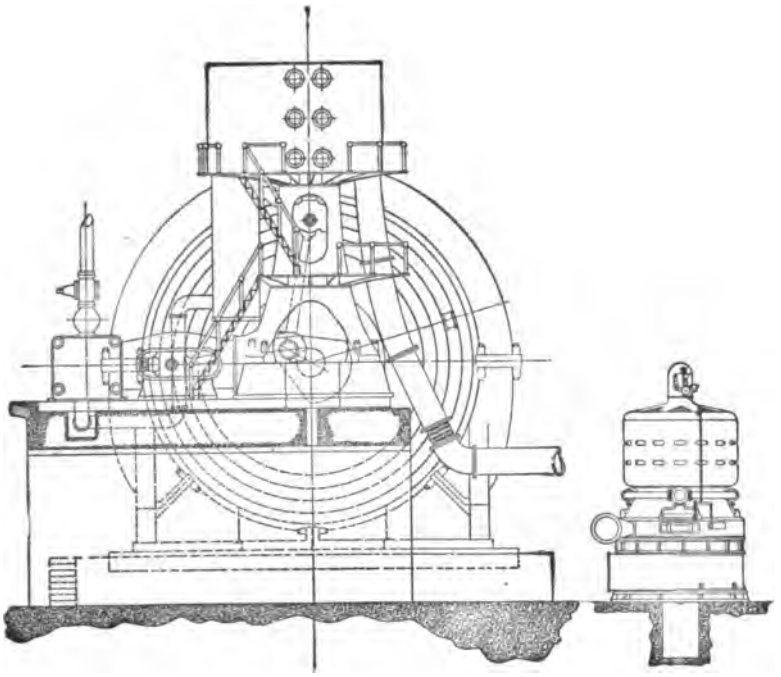


FIGURE 7.—COMPARISON OF 5,000 KW. CORLISS ENGINE AND 5,000 KW. CURTIS TURBINE.

FLOOR SPACE.

The floor space occupied by the Curtis turbine is less than that required by any other steam prime mover similarly equipped of corresponding capacity, and the cubic area occupied much less than that occupied by the reciprocating unit, and no more than that occupied by any turbine and less than most of them.

STEAM CONSUMPTION.

The steam consumption of the Curtis turbine is a feature of the apparatus which has been much discussed and the limited data published in connection with the same, by its manufacturers has been frequently commented on. The reason for this apparent reticence was the extreme difficulty of making accurate tests under commercial operating conditions and the realization

by them that if their guarantees were not evidence enough of their ability to produce results, shop tests would be little more convincing.

They have therefore preferred to wait until such time as the users of the apparatus should be in a position to make tests themselves, under such conditions that the manufacturers should have no connection with them to the extent of in any way influencing the results.

Before quoting the figures allow me to call your attention to the fact that all results are given in pounds of steam per kilo-watt hour.

I trust you will pardon me if I call your attention to the difference between the kilo-watt hour, the indicated horse power, the brake horse power hour and the electrical horse power hour all of which are used in making guarantees on steam prime movers. My excuse for taking this up is not any intimation that you lack knowledge on the subject, but that many people being accustomed to carrying indicated horse power results in their mind, from lack of careful consideration are liable to carry in their minds the figures named per kilo-watt and apply them on an indicated horse power basis in thinking of them later.

Let us start with twenty pounds of steam per kilo-watt, or in other words twenty pounds of steam per one thousand watts.

An electrical horse power is 746 watts, and therefore a kilo-watt is 1.34 horse power.

From the above it is evident that the steam consumption per electrical horse will be $\frac{746}{1000}$ of what it will be for a kilo-watt or 14.92 pounds. Now if we deduct the friction windage, magnetic and electrical losses in the generator we shall arrive at the brake-horse-power. These are liable to vary according to the design of the generator from five to ten per cent.

Let us select the medium, say seven per cent., or in other words, the steam consumption per brake horse-power will be ninety-three per cent. of what it is per electrical horse-power or 13.88 pounds.

Now to obtain the indicated horse-power we must esti-

mate the friction of our steam unit, and having nothing on which to base an estimate on this item we must revert to the reciprocating engine. Here we must assume a figure let us select seven per cent. as being fair.

The steam consumption per indicated horse-power will be ninety-three per cent. of what it is per brake horse-power or 12.9.

We now have the following that

20	pounds	per	kilowatt
14.92	"	"	electrical horse-power
13.88	"	"	brake horse-power
12.9	"	"	indicated horse-power

are equal.

Therefore published results of turbine tests which give the results in other than kilo-watts are incomplete.

Results computed from those obtained after the steam had passed one of the early stages of the steam units would be of as much use as brake horse-power results. The only results which leave absolutely nothing for assumption are the pounds of steam per kilo-watt. But, you say, why not make it complete and give results in pounds of specified fuel per kilowatt?

This obliges me to call your attention to the fact that the turbine or engine manufacturer is not responsible for the boiler plant where the evaporation may be anything from six to ten pounds of water per pound of coal. We must therefore be content with the turbine performance.

The results of tests which follow have been furnished by the parties for whom they were conducted and the writer wishes to take this opportunity of thanking those who have so kindly consented to their use. These figures were in each case procured by the owners without the manufacturers having any connection with the tests or the results.

Professor BULL says in discussing a paper on turbines read before the American Society of Mechanical Engineers, May, 1904, at Chicago, referring to tests therein mentioned: "The results as to efficiency quoted and obtained by tests conducted

by the manufacturers themselves will not be recognized as facts by the engineering profession." Appreciating this to be a fact the manufacturers of the Curtis turbine have studiously abstained from publishing figures, with regard to steam economy, procured by tests either at their factory or elsewhere, with which they were in any way connected.

The manufacturers of the Curtis turbine, as well as the writer disclaim any responsibility for the figures which follow, as in each case they have been furnished through the kindness of those making them but we are pleased to vouch for the honesty and ability of those who made the tests, who had no other object in view than to ascertain the facts.

NEWPORT, R. I.

During March, 1904, GEORGE H. BARRUS tested for the Old Colony Street Railway Company, at Newport, R. I., the first vertical shaft Curtis turbine ever put into commercial service.

This turbine was of 500 KW. capacity and (as before stated) left the factory, February 24, 1903 and had been in continuous service for nearly a year when the test was made. The results of this test with 150 pounds of dry saturated steam 2 inches back pressure in the condenser were,

Load	Steam Gauge Press	Super-Heat Deg. F.	Vacuum Inches.	Absolute back pressure inches.	Lbs. Steam per KW. hour inches.
½	150	0	28	2	21.38
¾	150	0	28	2	20.69
1	150	0	28	2	19.78
1½	150	0	28	2	20.22

The speed variations from no load to full load was .8 of one per cent. The highest temperature reached by the generator after eight hours run with a load of 660 kilowatts was 38 degrees C above the room temperature, at the completion of which it was run for two hours with a load of 764 kilowatts without further raise of generator temperature.

With the variable commercial load of the station consisting of street railway, stationary power and lighting with the load varying from 333 kilowatts to 114 kilowatts and averaging 253.2 kilowatts the steam consumption with dry saturated steam was 22.38 pounds per KW. hour.

When a water rheostat load was added to the above variable load sufficient to bring the average load up to 421.9 KW. the consumption of dry steam was 20.7 pounds per KW. hour.

With 150 degrees F. of superheat at the throttle, the steam consumption at full load was 15.91 pounds per KW. hour.

When the turbine was carrying the commercial load of the station, which averaged 253.2 KW. or about half load for the unit and was independently operated with one of the boilers, the boiler being fed through the economizer by one of the steam pumps of the station, taking steam from the same boiler, the super-heater being out of service, the total consumption of dry coal used for all purposes on a fifteen hour run amounted to 2.5 pounds per KW. hour.

The cost of this coal per 2,240 pounds being $4.05 represents a total fuel cost of forty-seven one hundreths of a cent per KW. hour.

DOVER, N. H.

August 11th and 12th, Professor C. A. REED in charge of the Department of Engineering and A. F. NESBITT, Professor of Electrical Engineering and Physics of the New Hampshire State College of Agriculture and Mechanics Arts of Durham, N. H., made a 24 hour test of a Curtis vertical shaft turbine of 500 KW. capacity, the property of the United Gas & Electric Company of Dover, N. H., with the following results:

Average gauge pressure of steam at turbine 142 pounds.
Average super-heat at turbine 113 degrees F.
Average vacuum (inches mercury) 27.8 inches.
Average load 352 kilowatts.
Steam per kilowatt hour 20.5 pounds.

JOLIET, ILL.

November, 1904, Messrs. SARGENT & LUNDY, Chicago Engineers, made a test on a Curtis vertical shaft Turbine of 500 KW. capacity, the property of the Economy Light & Power Company of Joliet, Ill., with the following results:

Average gauge pressure dry saturated steam	140.9 pounds.
Average vacuum	28.22 inches.
Average absolute back pressure in condenser	1.15 inches.
Average moisture in steam at throttle	1.4 per cent.
Average load	531.2 KW.
Average steam per KW. hour	21.08 pounds.

The steam pressure during this test varied from 133 to 146 pounds gauge pressure.

The load was obtained by averaging the readings of the generator wattmeter taken each minute during the test.

The load varied from 465 KW. to 575 KW.

The engineers making this test state as follows:

"During the test, the turbine was running on a commercial load, in multiple with the generators in the water power plant and on account of the great fluctuation of the load the steam consumption is unquestionably not as good as would be obtained on a constant load."

"The turbine has frequently carried loads of over 750 KW. when running condensing for short periods."

"The temperature of the armature of the generator was taken November 11th, after the regular evening run, at an average load of over 500 KW. and was found to be 34½ degrees C. above the temperature of the room.

COLUMBUS, OHIO.

June, 1904, a test was made by Professor E. A. HITCHCOCK of the Ohio State University on a Curtis vertical shaft turbine of 500 KW. capacity, the property of the Columbus Railway & Light Company of Columbus, Ohio, with the following results, with dry saturated steam.

Average boiler pressure	158. pounds.
Average vacuum	28 inches.
Average load	519 KW.
Average steam per KW. hour	20.5 pounds.

A record was kept by the Columbus Railway & Light Company of the performance of this turbine during December 14, 1904, for the day, operating on commercial load, taking the total output from the recording water meters and weighing the condensed steam from the station including all auxiliaries and dividing the steam by the output with the following results, using dry, saturated steam.

Time	Average Steam press	Absolute Back press	Average load KW.	Average pounds Steam per KW.
8 to 9 A. M.,	150	2.2″	128	30.4
9 to 10 A. M.,	149	2.2″	120	30.19
10 to 11 A. M.,	155	2.2″	121	30.92
11 to 12 A. M.,	153	2.2″	85	34.27
12 to 1 P. M.,	154	2. ″	279	22.44
1 to 2 P. M.,	154	2. ″	327	21.22
2 to 3 P. M.,	154	1.9″	445	20.17

Mr. M. S. HOPKINS of the Columbus Company, says in connection with the above record.

"The tests were made while the turbine was working on regular commercial lighting load without any special preparation whatsoever and showing the actual commercial results which we are obtaining from the turbine under extreme varying load conditions."

OTTUMWA, IA.

April 5th, 1905, a test was made by JOHN WISHART, Consulting Engineer, Chicago, Ill., of a Curtis vertical shaft turbine, of 500 KW. capacity, the property of John Morrell Company, Ltd., at Ottumwa, Ia., with the following results.

I will call your attention to the fact that in this case the steam

consumption includes that used by the exciter and hot well pump.

Average load KW.	Average pounds guage press steam	Average quality of steam per cent.	Average vacuum inches	Average barometer inches	Average pounds steam per KW.
250	154.6	98.59	27.46	29.17	23.813
500	141.17	98.59	27.193	29.179	22.17
625	147.	98.8	27.175	29.18	21.38

The above full load results corrected for 150 pounds pressure and two inches absolute back pressure in condenser, result in a steam consumption of 20.957 pounds per K. W. hour and the other loads in proportion.

CORK, IRELAND.

Late in 1904 a test was conducted by CHARLES H. MERTZ on a Curtis vertical shaft turbine of 500 K. W. capacity owned and operated by the Cork Electric Tramway and Lighting Company of Cork, Ireland.

This turbine had been in operation about a year when the test was made with the following results: —

Load	Steam press	Superheat deg. F.	Vacuum inches	Pounds steam per KW. hour
¼	155	51	28.8	24.9
½	155	51	28.6	22.64
¾	155	70	27.9	20.95
1	153	104	26.9	20.6
1¼	151	124	26.2	21.

This was one of the first turbines shipped by the manufacturers.

OSHKOSH, WISCONSIN.

In December 1904, the Oshkosh Gas Light Company of Oshkosh, Wisconsin, installed a Curtis vertical shaft turbine of 500 K. W. capacity and after it had been in commercial service for about four months, the load had increased so that the company decided to install another turbine; with a view to determining

whether the turbine had compiled with the guarantees in the purchase contract and whether the machine was a commercial success, the Oshkosh Gas Light Company decided to have a thorough test made, and retained for this purpose H. M. Byllesby & Company, Consulting Engineers of Chicago.

The following are the final results of the test and I would call your special attention to the twelve-hour commercial run, the result of which are of particular value, inasmuch as during this run the turbine was operating on the regular station load at a very poor load factor.

AVERAGE CONDITIONS.

Load KW.	Pounds guage press steam	Quality steam per cent.	Inches vacuum	Inches barometer	Pounds steam per KW. hour
250	150	98.2	26.79	29.4	25.99
499	141.75	98.2	26.40	28.97	22.64
611	142.2	98.2	26.40	29.01	22.28
COMMERCIAL RUN AVERAGE LOAD.					
26.27	146	98.2	26.29	29.24	26.34

The turbine consumed 29.23 pounds of steam per KW. at half load, 24.78 pounds per KW. at full load and 23.69 pounds per KW. at 122.2 per cent. load including all auxiliaries also a steam driven exciter, but did not include the boiler feed pump.

It consumed 31.7 pounds of steam per KW. on the commercial run with the load averaging 262.7 KW. including all auxiliaries together with the boiler feed pump.

After applying corrections for condenser leakage, step-bearing overflow, quality of steam, initial steam pressure, and vacuum (two inches absolute back pressure) the following results were obtained.

HALF LOAD.

250 KW. 24.29 pounds steam per KW. hour.

FULL LOAD.

499 KW. 20.54 pounds steam per KW. hour.

OVER LOAD.

22.2 per cent. 611 KW. 20.19 pounds steam per KW. hour.
Commercial run average, 262.7 KW. 23.89 pounds steam per KW. hour.

The seven machines the tests of which have been given were all of the earlier designed type, those which follow of the same capacity are of later type.

REVERE, MASS.

Early in 1906 a test was made by students from the Mass, Institute of Technology under the direction of W. H. TRASK. Jr., on a 500 KW. vertical shaft turbine operating in the station of the Suburban Gas and Electric Company at Revere, Mass., with the following results.

Load KW.	Pounds guage press steam	Per cent. moisture in steam	Vacuum inches	Back press in condenser.	Pounds steam per KW.
281.9	152	1.2	28.52	1.76 inches	21.43
379.45	149.6	1.3	28.16	1.89 "	20.25
521.9	152	1.2	28.78	1.21 "	18.75
788.2	150.4	1.7	28.27	1.75 "	19.26

LYNN, MASS.

During the summer of 1905 the Lynn Gas and Electric Company of Lynn, Mass., installed a 500 KW. vertical shaft Curtis turbine and in the latter part of the same year their business had increased to the extent of obliging them to make a further increase of 1,500 KW. in their station capacity and they were somewhat undecided as to whether they would purchase a turbine or an engine. Some of their people feeling that while as a mechanical proposition the turbine was to be preferred they were quite sceptical with regard to its efficiency and with a view to determining this point instructed their Chief Engineer to make a careful test of the turbine and at the same time to carefully test one of their Corliss type engines under the same conditions and with the same load. The engineer in complying obtained the following results from the turbine.

Load in KW.	Pounds guage press steam	Superheat deg. F.	Inches vacuum	KW. excitation required	Pounds steam per KW. hour
296	150	75	29	5.04	19.25
504	150	70	29	5.70	17.25
711	150	75	29	6.00	16.91

Evaporation 8.5 pounds of water per pound of coal.
Coal consumption 2.05 pounds per KW.

The total water consumption per KW. of turbine and all auxiliaries, air pump, circulating pump, step pump, oil pump, boiler feed pump and exciter: in fact, total water consumption per KW. necessary to deliver a kilowatt from the boilers to the switchboard was as follows: —

296 KW. (½ load)	20.67 pounds.
504 " (full load)	18.00 "
711 " (1½ load)	17.44 "

The results obtained from the engine were as follows: —

Load in KW.	Pounds gauge press steam	Superheat deg. F.	Inches vacuum	KW. excitation required	Pounds steam per KW. hour
462	120	55	27	15.81	21.53
636	150	75	26	17.70	21.03

The Chief Engineer Mr. F. L. JOHNSON says: —

"These results were obtained by a set of men absolutely free from prejudice, men who wanted only facts, and these results are what have made me say that I was ready to take off my hat to one turbine." It is needless to say that they placed their order for a 1,500 KW. turbine which is now in operation.

WATERLOO, IOWA.

At the Iowa Electrical Association convention at Des Moines, April 18th, 1906, figures on the test of a Curtis vertical shaft steam turbine of 500 KW. capacity at Waterloo, Iowa were given by AUSTIN BURT, Superintendent, and NIELS CHRISTENSEN, Chief Engineer of the Electrical Department of the Citizen's Gas and Electric Company, in which company's station the turbine was installed.

The tests were made by the operating company.

The turbine was placed in service February 9th, 1906.

The turbine exhausted into a surface condenser.

The Edwards air pump was operated by a 11 H. P. motor.

The circulating pump was driven by a 30 H. P. motor.

Exciting current was furnished by a 25 KW. horizontal shaft Curtis steam turbine, the steam from which is used for heating the feed water in an enclosed heater.

Steam from the boiler feed pump is also used in the same heater.

The turbine was tested at half load, full load, 50 per cent. overload and on variable station load averaging 366 KW. Following the turbine test a series of three tests was made on two reciprocating engine-driven units.

These units are: one 450 H. P. cross-compound condensing engine, direct-connected to a 300 KW. alternating current generator and one 200 H. P. cross-compound condensing engine direct connected to a 133 KW. alternating current generator.

The condenser equipment is of the WHEELER admiralty type, with water, steam and air piston on one rod.

These units are excited from a turbine exciter.

The conditions of this test were as follows:

The 300 KW. set was run alone at full load, then both sets were run in parallel with the variable station load.

TEST.

Average in KW.	Pounds gauge press dry saturate steam.	Inches vacuum.	Pounds of steam per KW. hour by turbine.	Pounds of steam required by step and oil pump.	Pounds of steam required by cir. and air pump.	Pounds of steam required by exciter.	Pounds of steam required by all auxiliaries.	Pounds of steam required by turbine and all auxiliaries.	Total pounds coal per KW. hour.
253	150	27.87	21.67	.47	2.86	1.61	4.94	26.61	4.09
518	147	27.81	19.61	.24	1.28	.95	3.27	22.08	3.27
750	150	28.02	19.52	.18	.88	.65	1.71	21.23	3.34
*366	149	26.91	21.82	.31	2.01	1.05	3.37	25.19	3.87
†301	147	21.7	21.34	—	1.46	3.32	4.78	26.12	4.03
‡432	141	20.42	23.34	—	1.28	2.36	3.64	26.95	4.24
§292	129	22.29	26.52	—	1.89	3.25	5.14	31.68	4.88

* 366 KW. represents the average of variable station load on turbine.
† 301 KW. represents the steady test load on one reciprocating engine.
‡ 432 KW. represents the steady test load on the two reciprocating engines.
§ 292 KW. represents the average of variable station load on both engines.

There are several deductions which may be made from the foregoing figures.

The statement has frequently been made that when the steam consumption of the auxiliaries necessary for use with the turbine was included the saving over the engine was not so apparent.

Let us compare the full load of figures.

Turbine alone without auxiliaries	19.61 pounds.
Engine alone without auxiliaries	23.34 pounds.
Turbine auxilaries alone	2.45 pounds.
Engine auxiliaries alone	3.64 pounds.
Turbine and auxiliaries	21.23 pounds.
Engines and auxiliaries	26.95 pounds.
Total coal per KW. turbine complete	3.27 pounds.
Total coal per KW. engines complete	4.24 pounds.

The steam consumption of turbines alone is 19 per cent. better than of the engine.

The steam consumption of turbine auxiliaries is 48 per cent. better than that of the engine auxiliaries.

The steam consumption of turbines complete is 27 per cent. better than that of the engines and the coal consumption of the turbine is .97 of a pound per KW. less, while on the variable commercial load of the station which represents the day in and day out conditions under which the earnings of the station must be figured the gain is still more marked in favor of the turbine.

Let us compare these figures of steam consumption per hour.

Turbine alone	21.82 pounds per KW.
Engines alone	26.52 pounds per KW.
Turbine auxiliaries	3.37 pounds per KW.
Engines auxiliaries	5.14 pounds per KW.
Turbine and auxiliaries	25.19 pounds per KW.
Engines and auxiliaries	31.68 pounds per KW.
Total coal per KW. turbines	3.87 pounds per KW.
Total coal per KW. engines	4.88 pounds per KW.

Efficiency of turbine alone 26 per cent. better than that of the engines.

Efficiency of turbine auxilaries 52 per cent. better than that of the engines, station complete and the coal consumption of the turbine 1.01 pounds per KW. less.

Therefore, it will be seen that the turbine auxiliaries consume less steam for a given load than the engine auxiliaries under all conditions.

Now let us determine if possible what this saving of a pound or 20 per cent. of the coal means in dollars and cents.

Let us assume the price of coal to be $3.00 per short ton, which is fair for New England and assume a variable load averaging 300 KW. for 10 hours a day, 300 working days a year, the cost of coal for operating the engines would amount to $7,900.00.

A saving of 20 per cent. of this amount equals $1,580.00 per year, which sum capitalized on the basis of 5 per cent. equals $31,600.00 or nearly twice the first cost of a 500 KW. turbine and in the case of an electric lighting, power or railway company the saving would be even more marked as they operate 365 days instead of 300.

These figures take no account or the extra labor necessary to handle the extra coal, remove ashes, or lower maintenance cost of the turbine.

Another point worthy of consideration and to which I would call your especial attention in all these tests is the high efficiency of the turbine at overload.

The result of this is that the maximum overload capacity of the boiler plant is diminished in proportion to the dimunition of the overload efficiency of the generating unit.

Since the maximum load capacity is the real limit of investment in most steam plants, it will be readily seen that the overload economy of engines or turbines has a dominating effect upon their cash value.

For instance, a machine which demands an increase of ten per cent. in water rate at maximum sustained overloads will require a corresponding increase in investment in the boiler plant in order to make its overload capacity available or com-

pared with a Curtis turbine will proportionately reduce the maximum load capacity of the station and consequently will make necessary a corresponding increase of total investment for a given purpose.

When the small proportion that the cost of the generating units bears to the total plant investment is considered, the importance of this point is obvious.

LONDON, ENGLAND.

A test was made early in the present year by Mr. C. P. SPARKS, Chief Engineer of the County of London Supply Company of London, England, on a 1,500 KW. Curtis vertical shaft turbine located in their Wendswirth station.

The London Electrician in an article descriptive of this test, refers to the great value of independent tests and calls attention to several points of interest.

The full load steam consumption of the turbine without auxiliaries was 17.25 pounds per KW. hour.

With all auxiliaries the steam consumption at full load was 17.6 pounds per KW. hour.

This would indicate that the auxiliaries required three per cent. of the steam.

During the test the auxilaries required power as follows:

Circulating pump	36. KW.
Exciter	7.25 KW.
Air pump and step pump	6.75 KW.

A total for all auxiliaries of 50 KW. or 3⅓ per cent.

During the test superheat varied from 48 degrees to 62 degrees F. and the steam pressure from 146 to 154 pounds.

Vacuum 28 inches referred to a 30 inch barometer.

RUGBY, ENGLAND.

Early in 1905, a test was made by H. F. PARSHALL on a Curtis vertical shaft turbine of 1,500 KW. capacity at the station

of the Yorkshire Electric Power Company from which the following data was secured:

Steam pressure (gauge)	144 pounds.
Superheat	69 degrees F.
Vacuum	28½″
Full load water rate	17.53 pounds per KW. hour.

Turbine fitted with surface condenser 4,500 feet cooling surface.

Circulating water required did not exceed thirty times weight of water evaporated.

Temperature of circulating water	35 degrees F.
Temperature of suction water	74 degrees F.
Air pump required	8.6 KW.
Excitation required	5.25 KW.

CHICAGO, ILL.

A test was made by SARGENT & LUNDY of Chicago for the Commonwealth Electric Company of Chicago, Ill., on a vertical shaft turbine of 2,000 KW. capacity with the following results:

Load in KW.	Pounds steam gauge press.	Superheat degrees F.	Inches absolute back press.	Pounds steam per KW. hour.
555.	155.5	204	1.45	18.09
1,066.7	170.2	120	1.40	16.31
2,023.7	166.3	207	1.49	15.02

CHICAGO, ILL.

In March, 1906, SARGENT & LUNDY of Chicago made a test on one of the Curtis vertical shaft turbines of 5,000 KW. capacity installed at the Fisk St. station of the Commonwealth Electric Company of Chicago, which has been in commercial service for about one year.

All the tests enumerated were made under regular commercial load.

175 pounds steam pressure (gauge).
150 degrees F. Superheat.
1.5″ absolute back pressure.

2,500 KW. (½ load)	water	rate	per	KW.	17.74	pounds.
3,750 KW. (¾ load)	"	"	"	"	17.08	"
5,000 KW. (full load)	"	"	"	"	16.62	"
6,250 KW. (1¼ load)	"	"	"	"	16.52	"
7,590 KW. (1½ load)	"	"	"	"	16.90	"

I would call your particular attention to the flat water rate which results in a difference in steam consumption of but .84 of a pound per KW. from half load to load and one half.

I feel that our friends have by the foregoing figures demonstrated the fact that the Curtis turbine is a very efficient steam prime mover and that a careful analysis of the figures and the conditions under which they were derived will convince you that it will be extremely difficult, if not impossible, to find a combined steam electric unit which can equal these results under commercial operating conditions and as we have now discussed pretty thoroughly its performance, let us take up some of the results of its use, considering first, its reliability.

RELIABILITY.

As before stated insurance against interrupted service was the first consideration in the design of the Curtis turbine.

The builders of the Curtis turbine endeavored to design first a "fool proof" machine and one which would be rugged and of such character as would remain operative under all conditions, they then aimed to make as high as possible the efficiency which resulted from this substantial design; they fully appreciated the fact, that interrupted service would cause the electric railway, lighting or power distributing company serious inconvenience. They also knew that although these parties were accustomed to maintain more than one power producing unit which would enable them to tide over minor interruptions but they further realized that while unreliability would seriously handicap the the turbine for this use, it would make its use absolutely pro-

hibitive by a textile mill or other manufacturiug industry which placed its entire dependence on a single prime mover.

The results given under the last heading, will, I hope, leave little doubt in your minds with regard to efficiencies and I trust that having followed me to this point, that I have convinced you that its construction is such as insures its continuity of operation.

With a view to satisfying any doubts still lingering in your mind let us briefly review some of its more important characteristics.

The generater design is as good as the best and better than most and as you are familiar with the reliability of this feature, we will discard its further consideration with the statement, that it is the most ruggedly constructed of all the generators at present on the market.

As previously explained the unit cannot be injured by quick starting, for steam can be admitted as quickly as possible, even if the turbine is stone cold.

Water can pass through it without injury.

Admission valves may become inoperative and others will automatically and efficiently take their place.

Vacuum may be lost and the turbine will efficiently carry full load non-condensing without its being necessary to by-pass steam.

Shaft cannot sag or buckle as there is absolutely no lateral strain on it due to weight or otherwise.

Shell cannot crack, warp or distort as live steam is not in contact with it.

Steady bearings losing lubrication cannot put the turbine out of commission, for should they run dry, there being no weight on them and the sleeve on the shaft being the harder, would enlarge them to the extent of whatever bearing there might be (under running conditions) and it would continue to spin on the step.

Should we lose our step pressure, the auxiliary step pump would be automatically started and the operator notified by an

automatic alarm of the fact and should this for any reason fail to respond, the step is so arranged that the blocks can be raised as they wear, until either the pressure is restored, or the step blocks worn out, when the turbine would come to rest by friction, without injury other than making necessary the replacement of the worn blocks and the re-adjustment of whatever had interfered with the lubricant, a matter of short time and slight expense.

Under no conditions, can buckets or intermediates come in contact with anything that would tend to injure them, nor can either become disconnected or in anyway disarranged.

The design, construction and operation of the Curtis turbine is such as to cause no undue stress on the piping, boilers, foundations or other auxiliaries to the extent of tending to result in leaking joints, steam-hammer or lateral strains that would in any way jeopardize the continuity of operation of any single item of the complete plant.

ADVANTAGES.

There are many advantages to be derived from the use of the Curtis turbine other than those already enumerated. Allow me to call a few of them to your attention and briefly discuss such of them as are not apparent or have not already been taken up.

The installation of the Curtis turbine from its compact design results in a marked saving in land, buildings, fonndations and equipment.

Its operation results in a saving in taxes, insurance depreciation, repairs, fuel, water, oil and attendance, in fact while local conditions vary the amount of these different items of saving it is the exception rather than the rule, where its use does not effect a saving in every item which goes to make up the cost of operation.

In support of the foregoing allow me to quote Mr. CHARLES M. BLACK, General Manager of the Metropolitan Street Railway Company of Kansas City, Mo., who says under date of January 30th, 1905.

"You will note from the blue print enclosed, that we have floor space in the station for six 5,000 KW. Curtis turbines."

"These six turbines will occupy exactly one-half of the engine room, the other half being taken up by three 3,000 KW. engine driven units."

"In other words, we will be able to install in turbine driven units 30,000 KW. in the same space as is required for 9,000 KW. in engine driven units."

With regard to the saving in operating expense in connection with the use of the Curtis turbine, Mr. B. F. BURT, General Manager of the Chattanooga Electric Co., of Chattanooga, Tenn. who at the time of writing, March 3rd, 1905, had been operating three 500 KW. turbines about eight months says.

"Since installing the turbines we have brought the operating expense down to less than fifty per cent."

Under date of December 2nd, 1905 after sixteen months of continuous operation he says: —

"In our opinion a comparison between the Curtis turbine and a large compound condensing engine is all in favor of the turbine, every way you take it, floor space, consumption of coal and water, lubrication, repairs and labor."

From Mr. BLACK'S letter it will be noted that a Curtis turbine station of a given capacity is practically one-third the size of the same capacity reciprocating engine station and from Mr. BURT'S letter that operating expenses are much reduced.

There are other advantages resulting from the use of this machine, which while it is extremely difficult to figure their worth in dollars and cents, make its adoption highiy desirable, among these may be named: simplicity, reliability, and ease of access to all parts.

All parts interchangeable.

Latest improvements applicable to earliest machines, this is a point on which great stress is laid by the manufacturers to so design each improvement as to make it applicable to machines of earlier design.

No adjustments desirable or possible, for test conditions are

always running conditions. It would therefore be impossible with a Curtis turbine to adjust it with a view to making a test and making the adjustments finer than would be permissible under commercial operating conditions, procure attractive results which would afterwards be found impracticable under operating conditions.

As previously explained an improperly designed Curtis turbine can never be made to produce good results, for this reason you are not depending upon your engineer to keep your machine up to "concert pitch" it can't get away from it.

The absence of wear prevents the possibility of any falling off in economy with age.

The Curtis turbine assists in obtaining a high vacuum and benefits from it, there being no opportunity for air leaks makes it a comparatively easy matter to maintain a vacuum 28 to 29 inches referred to a 30 inch barometer.

Its continuous rotary motion without pulsations results in absolutely no angular speed variation, thus greatly assisting in maintaining perfect parallel operation with other units, and also results in no tendency to rack foundations.

The steam flow being steady and continuons all strains on parts are steady and continuous for which reason no part of the turbine or plant is in any way subjected to sudden and frequent strains, making necessary or desirable special provisions in any part of the plant to obviate the possibility of leaks.

The regulation is perfect and can perhaps be best compared to a perfectly regulated water wheel; this results in manufacturing plants operated from this machine being entirely free from flapping belts and consequent belt wear and angular variation in the speed of producing machinery.

The Curtis turbine maintains extremely high efficiency under widely varying loads as will be noted by reference to the foregoing tests and perhaps the greatest gain from this feature is its high efficiency at extreme over-loads, where the ability of the boiler plant to supply the steam is the limiting feature in connection with the over-load capacity as previously explained.

The oversight of the engineer in attending to drips and the detrimental results from neglecting them are absent in this particular type of turbine from the fact that there are no drips and the machine is capable of discharging any accumulation of water without inconvenience as previously explained.

From the fact that oil is not brought in contact with the steam unit, either on its interior or exterior, there is not the remotest possibility of oil entering the steam, for this reason the condensed steam delivered by the Curtis turbine is distilled water absolutely clean, and in this respect it differs from any other steam prime mover ever put on the market. We will take this feature up more in detail under the next subject.

FLEXIBILITY.

The fact that the steam is in no part of the Curtis turbine brought in contact with any foreign substance that would in any way tend to change its character, makes it applicable to bleaching, dyeing or any other work where the use of absolutely clean steam at any pressure is desired, for it can be delivered at different pressures from different stages of the machine, or where distilled water is desirable, absolutely free from foreign matter, the Curtis turbine will deliver it. I will touch but lightly on this phase of the subject, for I hope at no distant day we may have the pleasure of hearing from members of this Association much better fitted than the writer to give the results of these conditions obtained from experiences in four large New England Textile Mills with which they are connected, where it is proposed by the use of the Curtis turbine to abstract from the steam for power purposes, that portion of its energy not required for use in preparation work, or in other words to use the turbine as a power producing reducing valve.

Another field for use of the Curtis turbine is the result of certain local conditions, which will be best explained by describing one or two installations.

The Thirteenth and Mt. Vernon Streets Station of the Philadelphia Rapid Transit Company is located at such a distance from

the water necessary for condensing that the engines at this station had always been operated non-condensing.

At this plant there are installed four 1,500 H. P. and one 2,200 H. P., Wetherell Corliss engines.

The 1,500 H. P. engines are each direct-connected to a generator, developing an average of 2,000 amperes at 575 volts.

It was found desirable to increase the capacity of this station and the matter was carefully considered by the engineers, and it was finally decided to install an 800 KW. low-pressure Curtis turbine, taking steam, at approximately one pound above the atmosphere and expand it to 28 inches of vacuum obtained by the installation of a surface condenser and cooling tower.

The turbine generator being connected to the same buss bars in multiple with the generator driven by the engine from which the turbine received its energy, obviated the necessity for equipping the turbine with any governor, as its regulation was perfectly automatic from the fact that should the voltage on the turbine tend to rise it would result in the load on the turbine increasing and the load on the engine would be correspondingly lessened and this would reduce the volume of steam passing through the engine and consequently the amount supplied to the turbine and it would immediately tend to drop back when a larger proportion of the work would be transferred to the engine set and this would require more steam, which it would deliver to the turbine, thus maintaining an absolute balance.

These favorable conditions resulted in the installation of a peculiarly simple form of turbine consisting of nothing as far as the steam unit is concerned other than the shell, wheels and expanding nozzles, omitting the governor and admission valves, with the result that the capacity of the station was increased approximately 66⅔ per cent., at an expense of less than half of that possible by any other method.

Considering this one unit by itself, the original installation probably cost between $100 and $150 per kilo-watt, including all costs, and the increase in capacity of 66⅔ per cent., at not more than half this amount.

Viewed from an operating standpoint, outside of the interest and depreciation on the addition it did not cost the Philadelphia Transit Company one dollar more to put 2,800 KW. into their switch-board than it formerly cost them to deliver 2,000 KW.

That is to say, this additional 800 KW. did not call for the consumption of an additional pound of coal and the simplicity of the added apparatus was such that it required no additional labor.

Another similar Curtis turbine adaptation is that made by the Scranton, Pa., Railway Company who have installed four Corliss simple non-condensing engines, direct-connected and belted to generators, the combined normal capacity of which is 2,300 KW. The conditions of operation are such that while the average output of the plant is 1,500 KW., there are times when the plant is seriously overloaded for short periods.

These four engines exhaust to the atmosphere through a common exhaust header from the top of which is a pipe open to the atmosphere. A pipe is taken from this common exhaust main to supply steam to a 500 KW. Curtis turbine similar to the one previously described, the steam expanding from the atmospheric pressure to 28 inches of vacuum, which is produced by a surface condenser, circulating water being obtained from the Lackawana River, 450 feet distant, and raised about 54 feet to the condenser head.

This turbine will develop its rated output with a steam consumption of about 38 pounds of steam per KW. hour approximately 19,000 pounds of steam per hour.

The engines at 30 pounds per horse power per hour and developing 3,000 H. P. will deliver 90,000 pounds of steam per hour, so it will readily be seen that as the load increases there is ample margin for further increase in this same line.

The conditions of operation in this case are similar to those in the former case, in that the generators are multiplied on common busses and regulation is wholly accomplished electrically thus obviating the necessity of mechanically governing the turbine.

But you may say that the above described conditions are not ideal conditions, or conditions of operation in an ideal power plant to the extent that a large proportion of well designed power plants are so located that they can be economically operated condensing. But the above device converts a plant already installed, into one of greater capacity at a minimum first cost as well as cost of maintainence.

The conditions under which a Curtis low pressure turbine can be installed with benefit to the user in connection with a condensing steam plant, while not productive of so large a percentage of increase, are such as will result in an increase of from 20 to 25 per cent. under these conditions, and at lower cost, as in this case, we have only to consider the cost of the turbine and the expense of the apparatus for providing the additional circulating water made necessary by the benefits derived from increasing the vacuum one or more inches which the use of the turbine makes possible.

In this case the additional power, or improvement in economy obtainable, will largely depend upon the characteristics of the engine or engines under consideration.

The principal merit of the low pressure turbine used under these conditions will be that it will increase the maximum output obtainable from the power plant, without increasing the boiler plant, and consequently entails but small increase in investment.

A 5,000 KW. engine plant was recently investigated where the maximum amount of steam available from the boilers for operation is about 120,000 pounds per hour and this when applied to the engine with a vacuum of 27 inch was capable of operating at about 22 per cent. overload. In this case the conditions of the engines were such that the addition of a low-pressure turbine would increase the maximum overload obtainable to 43 per cent. with the same vacuum of 27 inches. With a vacuum of 28 inches, the maximum overload obtainable would be increased to 53 per cent. Thus, with a vacuum of 28 inches, the increase of power amounted to 31 per cent. without additional fuel con-

sumption and the maximum output of the plant was increased by a similar amount.

If in this case more steam were available, it would pay to use a larger low pressure turbine and a much higher maximum could be obtained without loss in steam economy. I have in mind another case, a textile mill which is electrically operated having two generators of 1,600 and 2,300 KW. capacity respectively. Each generator is direct-connected to a horizontal cross-compound engine.

The load conditions at the present time are such that the all day output is 3,000 KW. This necessitates the continuous operation of both units and as they are synchronized on common busses they both operate at an uneconomical point.

The installation of a 500 KW. low pressure turbine, so arranged as to take steam from the exhaust of either or both engines, would result in their being able to carry the entire load from the larger unit, or if operated in series, with the smaller unit, would make it a relay for the larger unit practically of equal capacity, or used in conjunction with both units, would increase the total plant output by 500 KW. without increasing the fuel consumption.

When used in conjunction with the larger unit to carry the whole load this unit, as a whole (considering the turbine as an additional low-pressure cylinder), would result in better economy than would result from a triple expansion engine and would represent a vast saving over the operation of the two units operating at poor load factors.

TESTIMONIALS.

Feeling that it would interest you to know what satisfaction the first Curtis vertical shaft turbine which was installed in a textile mill in New England is giving, with the consent of the writer I take liberty to quote his letter on the subject.

NASHUA MANUFACTURING COMPANY.

MR. CHARLES B. BURLEIGH,
Boston, Mass.

Dear Sir:—In replying to your inquiry with regard to the perform-

ance of the three-phase, revolving field, alternating current, 600 volt, Curtis vertical shaft steam turbine, installed in our mill in January of this year, by Mr. CHARLES H. AUSTIN of this city, I would say that it has been most satisfactory in every particular.

The regulation is almost perfect and the attendance required is very much less than with a reciprocating engine.

We have no expense whatever in the way of repairs and were we contemplating the installation of additional apparatus, we would certainly install more units of this character."

Respectfully yours,

R. S. MILLIKEN, *Agent.*

I feel that one of the best testimonials which the Curtis turbine could have, is the fact that none of those who have ever used them have ever added to their capacity by the installation of reciprocating units, while seventy users have purchased a second, twelve have purchased two additional units, eight have added three units, six have added four units, three have added seven units and one concern has from time to time in the last three years purchased fourteen units. In other words, approximately 250 concerns have purchased Curtis vertical shaft turbines. One hundred of them, or 40 per cent, have placed further orders for the same apparatus, which is pretty good evidence of two things, first that results obtained confirmed their original judgment and second it indicates, in a way, that their business prospered under their use to the extent of making an increase necessary.

MEDALS.

It is the hope of the writer that he has in the foregoing description brought clearly to your notice some of the many points of the superiority of the Curtis vertical shaft turbine which are in part responsible for the high appreciation in which it is held by those familiar with it, as is evidenced by the fact that it was awarded the only grand prize presented by the committee of awards exclusively for steam turbines at the St. Louis Exposition in 1904 and also a gold medal, which was the highest award at the Lewis & Clark Exposition at Oregon in 1905.

Mr. CHARLES B. BURLEIGH. In opening this subject for discussion I hope that if there are any questions which occur to you you will not hesitate to ask them. There is much that I do not know about the turbine, but you are welcome to what I do know, and I hope if you are foggy on any point, that you will not hesitate to make it known.

I would like to ask Mr. MACCOLL if he will kindly read to you a little poem referring to turbines. It is written in a dialect which I do not feel familiar enough with to do justice.

Mr. MACCOLL. I am afraid that Mr. BURLEIGH has given me quite a proposition, but I will be very glad to make the effort.

THE RECEEPROCATIN' MON.

By Robert Burns and others, including Gavin Hamilton.

Oh! woesome 'oor that saw the birth
  O' turbine thocts in Pairsons' head;
I weesh that I wis aff the earth,
  Or else the turbine man wis deid.

I'm a receeprocatin' mon;
  I luve tae hear the bearin' bump,
Or yet the piston groan and grunt
  That's religated tae a pump.

This whurligeegin' thing I hate,
  For whutnae gude is it tae dae?
Tae sae the fearsome thing gurate
  Gars me puir stummuch gang agley.

I widna care if it had ocht
  Tae need a tender fitter's haund,
But it rins sae weel sin it was bocht
  I hivna had tae slack a glaund.

I hate the tribe of whurleegigs,
  It's jist a pinch o' steam, then "Scatt!"
I'm a receeprocatin' mon,
  I stan' or fa' wi' Jemmie Watt.

Mr. ARTHUR H. LOWE. I would like to ask Mr. BURLEIGH what units the manufacturers recommend; whether they produce one unit which is better than another? That is, are two 500 KW. units to be preferred over one unit of 1000 KW. capacity?

Mr. CHARLES B. BURLEIGH. This is a question governed almost wholly by local conditions. There should be in the design of the different units no preference with regard to one unit over another, local conditions should govern the desirability of installing one or more units. I feel, however, that the turbine should occupy such a place in the minds of manufacturers that they should feel that the desirability of dividing a 1,000 horse power plant into two 500 horse power units is less apparent, due to the rugged construction of the apparatus, using the Curtis turbine, than has in a great many cases formerly been the custom with reciprocating units.

Mr. WILLIAM D. HARTSHORNE. If I understand Mr. BURLEIGH correctly, his reply is equivalent to saying that the actual economy of a 500 KW. turbine is as good as that of a 5000 KW. turbine.

Mr. CHARLES B. BURLEIGH. I would not put it quite as broadly as that, although the added efficiency due to the use of the larger units is not so apparent in the turbine as is the case with the reciprocating engine. Perhaps that statement could be more clearly put by stating — that the falling off in efficiency, due to the reduction in size, is not nearly as apparent with the Curtis turbine as with the reciprocating engine. That is to say, there is not nearly the difference in efficiency between a 500 KW. and a 5,000 KW. Curtis turbine that there would be between a 500 and 5,000 KW. reciprocating engine set; as a matter of fact, the difference in steam consumption between these two turbines, under similar conditions of pressure, vacuum and load, would not exceed one pound. The first cost, how-

ever, and consequently the interest on the investment is proportioned more on an engine basis: that is to say, two 500 KW. turbines would cost more than 1,000 KW.

Mr. JOHN A. FERNLEY. I would like to ask Mr. BURLEIGH, referring to page 202, fourth line from the bottom, if he does not mean to say "takes in" instead of "eliminates"?

Mr. CHARLES B. BURLEIGH. I questioned myself as to just how to word that sentence so as to convey the idea I intended. The statement is intended to convey the idea that the figures quoted cover all the losses mentioned. In other words, none of the losses have been neglected or assumed and our ratings are based on the exact relation which the electrical or available working output bears to the steam or available working input. Possibly "includes" would have made this clearer.

Mr. C. J. H. WOODBURY. As illustrating the wonderful running balance which it is possible to obtain with the combination of the turbine and the generator, I was recently in the General Electric works in Lynn, and in the erecting shop was a 5,000 KW. turbine under test, and it was so very steady to the touch that I balanced a nickel on its edge near the top in this manner (illustrating with a coin on the President's desk), and the coin stood there without any overturn, although the speed of the periphery of the rotor of the generator was seven miles a minute. I was told that the way to know whether a turbine is running is to look at the governor balls at the top.

Mr. HOWARD D. COLMAN. Mr. President, I have heard frequently, particularly from reciprocating engine men that high vacuum was essential to the successful operation of the turbine. Possibly these remarks are intended for smaller sizes, but I should like to hear what Mr. BURLEIGH has to say with reference to these conditions.

Mr. CHARLES B. BURLEIGH. This subject has been fre-

quently referred to. The Curtis turbine is capable of maintaining a much higher vacuum than it is possible to maintain with a reciprocating engine, due to the fact that there are fewer opportunities for air to leak into the turbine.

A Curtis turbine designed for condensing operation will increase in steam consumption as the vacuum is reduced in about the same proportion as will a reciprocating engine operated under similar conditions. There is, however, less liability for finding it necessary to operate with a poor vacuum with the turbine than with the engine. I do not think that even the condenser people appreciate the ease with which a high vacuum can be obtained and maintained with the Curtis turbine.

Mr. HOWARD D. COLMAN. I would like to ask also whether in sizes so small that condensing would not pay at all, you consider that a turbine would show any economy over a reciprocating engine?

Mr. CHARLES B. BURLEIGH. Over a reciprocating engine of the same size, similarly operated?

Mr. HOWARD D. COLMAN. Yes.

Mr. CHARLES B. BURLEIGH. I certainly do. I would, however, eliminate size from the consideration and make operating conditions the determining factor as to the desirability of operating condensing or non-condensing.

Mr. HOWARD D. COLMAN. You then feel that the turbine will show better economy than the reciprocating engine, size for size under all conditions of operation, so far as vacuum is concerned.

Mr. CHARLES B. BURLEIGH. I do.

Mr. RICHARD H. RICE. I would like to say in connection with this subject that the reason why high vacuums are not

used on reciprocating engines is because of the enormous size of cylinders, valves, etc., which would be necessary to properly utilize a high vacuum. The volume of steam is twice at 28 inches what it is at 26 inches. It would involve an enormous increase in the size of the engine, increasing all the factors of lubrication, etc., if the engine were constructed to properly utilize 28 to 29 inches vacuum, whereas in the Curtis turbine it is simply a question of length of buckets.

Mr. HOWARD D. COLMAN. That is the reason, is it not, why in the instances Mr. BURLEIGH refers to in his paper, it was possible to add a turbine installation to the reciprocating engines, already in operation, where it would not have been profitable to install an additional cylinder?

Mr. RICHARD H. RICE. That is exactly the reason.

Mr. WILLIAM D. HARTSHORNE. I would like, Mr. President, to ask Mr. BURLEIGH to give us a specific instance, if he can, of the probable increased cost to maintain a 29 inch vacuum over a 28 inch vacuum compared with the increased amount of energy obtained.

Mr. CHARLES B. BURLEIGH. The last speaker has me stumped now; in fact the condenser people are themselves very vague in connection with the results to be obtained from condensing apparatus used in conjunction with turbines, due, in a way, to their education which has been in such lines as has obliged them to bend their energies to overcome the problems presented by the necessity for providing for the air leaks in the reciprocating engine, which conditions would necessitate a fabulous amount of circulating water at low temperature to maintain a 28 inch vacuum.

We find it extremely difficult to impress on their minds the ease with which this 28 inch vacuum can be maintained on a Curtis turbine with much less circulating water. They not having available figures and we not having the time or facilities for

procuring reliable data which I sincerely hope may be made available later, will unquestionably result in great benefit to the whole turbine situation.

Mr. WILLIAM L. LYALL. Some critics of the turbine question the life and durability of the buckets, due to the very high velocity of the steam. What would Mr. BURLEIGH have to say as to this?

Mr. CHARLES B. BURLEIGH. I touched lightly on this subject in the paper under the head of Wear. Possibly the best evidence I can give you in this connection would be to refer to the first turbine which was shipped from the works, which you will see by reference to the paper has been in commercial operation continuously for the operation of combined lighting, stationary power and railway work for some three years. This machine is today operating with the same buckets that were originally installed and they show no apparent change. We all admit that we would anticipate excessive wear if a piece of metal were held stationary and steam at high velocity were brought in contact with it at right angles.

The conditions in the turbine are, however, distinctly different, as will become apparent to you after a careful study of that part of the paper entitled Steam Velocity on page 171. The bucket is receding from the steam which comes in contact with it at an angle corresponding closely to the arc of the bucket. Under the same heading you will also notice that the conditions of maximum efficiency in any turbine, in any way dependent on impulse, are such as require that the actuated medium move at a speed one half that of the steam. Therefore, any wear which might occur would be in no way dependent on the speed of the steam, but on the relation which the speed of the steam bears to the speed of the bucket, which is and must be the same in all turbines operating at maximum efficiency.

As previously stated, no wear is in any way apparent after three years continuous use, therefore it surely can have no

marked effect or efficiency or continuity of operation in double that time, and knowing that all parts of the Curtis turbine with which the steam comes in contact can be renewed at an expense of less than five per cent. of the original cost of the apparatus, it cuts the depreciation, due to wear, down to where we know for a certainty that it is much less than one per cent. anyway, so this feature is a matter of such minor importance as to be hardly worth consideration.

Mr. GEORGE A. AYER. Do I understand that there is no apparent wear on steel in three years?

Mr. CHARLES B. BURLEIGH. We have been unable to discover any wear.

Mr. GEORGE A. AYER. I have heard that the buckets were liable to pit.

Mr. CHARLES B. BURLEIGH. It may be possible that they are liable to pit, but we have never discovered a pitted bucket in a Curtis turbine. An article appeared in one of the technical papers some two or more years ago, I think, which commented on the pitting or erosion of buckets, due to steam action, and photographs were published of buckets in rather a dilapidated condition, the result of steam wear. Afterward similar photographs were published in the same paper showing buckets which had been mechanically injured for the purpose of comparison, and the similarity of the two photographs was so marked as to make it impossible to detect which was which.

These were not Curtis buckets, and it was clearly proven and accepted that the injury was not due to steam wear. I do not think that any turbine manufacturer has ever experienced any wear from this cause.

Mr. GEORGE A. AYER. I think it quite likely that this was where I got my idea and then from the reiteration of the fact that repairs were so cheap, it occurred to me that perhaps it was likely to need repairs.

Mr. CHARLES B. BURLEIGH. I dislike to call on him, but there is a gentlemen present who saw the interior of a Curtis turbine that had been in continuous operation fourteen months. This machine was equipped with hand-filed buckets and we examine them very carefully and were unable to detect any change in their appearance. The file marks were as clearly defined on the buckets at that time as they were before the machine was put into service. If there is any doubt, I will ask this gentleman to substantiate my statement.

Mr. RICHARD H. RICE. I would like to say a word in regard to the cost of obtaining high vacuum.

I think this is a question which must be solved by the condenser people themselves: that is to say, I think the present condenser susceptible of considerable improvement, and that by such improvement it will be possible to obtain 29 inches vacuum in many cases where we now obtain 28 inches, and without additional cost for pumping. It must be borne in mind, however, that the temperature of the cooling water determines the amount of vacuum, and with cooling water of over 70 degrees, it will be impossible to obtain a vacuum of over 29 inches with the use of a finite amount of condensing water.

It is necessary in obtaining a high vacuum to have everything extremely tight, to have thorough and efficient means of cooling the air which leaks into the steam to be condensed and which exists in the steam.

We have gone as far as we could in assisting the condenser manufacturers to obtain high vacuum by putting our condensers very close to the turbines, and provided for efficient packing where the shaft passes through the shell.

I have this summer seen a condenser which had only 2.8 square feet of cooling surface per kilowatt where many of our condensers have four square feet per kilowatt, at the same time this foreign condenser giving 97 per cent. of vacuum which is very close to 29 inches.

Therefore, I think it is easy to see that in the near future we

shall be able to obtain 28 to 29 inches under favorable conditions of cooling water with the proper condensers and with very moderate expense for pumping.

Mr. EDWIN H. MARBLE. I heard a conversation a short time ago in Philadelphia between a textile manufacturer and the agent of a turbine manufacturer. The textile manufacturer said, "I don't know but we shall want two small turbines — quite small." The remark was immediately passed by the agent, "I don't think you had better consider a 100 horse power, if you are going to think of anything, put in the larger ones."

I asked the gentleman afterward if he had considered the smaller ones, and he said; "For small plants the inference that I have drawn from two different men was that the advantages of a steam turbine for small powers were nowhere near as apparent as with larger." I have heard that quite a number of times where in smaller plants that question has come up, two or three times to my knowledge, — where not over 150 horse power was required.

Mr. CHARLES B. BURLEIGH. I think very likely this impression may have been gained from the fact that the turbine agent was talking with a textile manufacturer.

In the successful operation of an electrically equipped textile mill, alternating current apparatus is much to be preferred to direct current apparatus. In fact, the Curtis turbine is the only turbine the design of which will permit of its direct connection and operation in connection with direct current generators. This being the case all other turbine manufacturers would naturally lean toward the recommendation of alternating current turbines.

No turbine manufacturer has as yet designed anything as small as a 150 kilowatt alternating current machine. The design of most turbines is such as will not permit of the development of a steam unit of small enough capacity for the operation of so small a generator. In fact, the Curtis turbine is the

only machine today on the market the design of which is such as permits of its development in any size which commercial conditions would make desirable from one horse power to 100,000 horse power.

EDWIN H. MARBLE. The inference that I gained and that gained by the manufacturer was that where the power was not over 100 to 120 horse power there would be no important advantage gained by the use of a steam turbine as there would be with a 500 or 1,000 horse power turbine as compared with a reciprocating engine.

Mr. B. CHARLES BURLEIGH. I can see absolutely no reason why there should not be the same proportionate advantage.

Mr. EDWIN H. MARBLE. The impression that I had then and the impression of the manufacturer was that the turbine agent was opposed to putting in a small sized machine, as it would not show the same relative proportion of advantage over the reciprocating that it would if he put in a 500 horse power or a larger sized machine.

Mr. CHARLES B. BURLEIGH. The difference in floor space occupied by a 100 horse power turbine and a 100 horse power engine would not be so marked as between 500 horse power sizes, but taken from an operating standpoint, I can see absolutely no reason why he should have advised against its use, unless it was due to ignorance.

The PRESIDENT. What is the most economical pressure to use for a 1,000 KW. engine? Assuming it to be 150 pounds, how much loss is there in using 120 pounds pressure?

Mr. CHARLES B. BURLEIGH. With a Curtis turbine designed for 120 pounds pressure we would expect very nearly if not quite as good efficiency from the lower as from the higher pres-

sure. That is, there would be a very slight difference with a turbine designed for that pressure.

The PRESIDENT. Does that cost more?

Mr. CHARLES B. BURLEIGH. In a way, yes, because if turbines were designed to most efficiently meet all pressure conditions from 50 to 200 pounds, it would result in so much special work that it would increase the cost of the entire turbine output. Consequently, for the benefit of the customer it is good judgment to establish a standard and keep as close to this standard as possible. Without reference, I should say that the falling off in efficiency due to the 30 pounds drop in pressure would be a matter of a very few per cent.

Mr. RICHARD RICE. Three per cent?

Mr. CHARLES B. BURLEIGH. I was going to say not over four per cent?

The PRESIDENT. What is the standard pressure?

Mr. CHARLES B. BURLEIGH. All machines of 1,500 KW. capacity and smaller are designed for 150 pounds and all larger for 175 pounds pressure.

Mr. HOWARD D. COLMAN. Mr. BURLEIGH made several comparisons between reciprocating engines and turbines on overloads. I would like to ask how the turbine compares with the reciprocating engine at underloads, say half load?

Mr. CHARLES B. BURLEIGH. The Waterloo curve on page 217 of the paper will show this. This is, however, dependent almost entirely on the design of the turbine. The curve of the Curtis turbine is particularly flat from half load to load and one-half and it is possible by changes in design to better the light

load efficiency at a slight sacrifice of over load efficiency or vice versa.

Mr. HOWARD D. COLMAN. You do not have any absolute fixed design in this connection, it depends on conditions?

Mr. CHARLES B. BURLEIGH. The normal curve of standard design would show as compared to full load a falling off of from one-half to three-quarters of a pound at one and one-half load, and a falling off at half load of from one and one-half to two pounds of steam per kilowatt.

Mr. ARTHUR H. LOWE. I would like to ask Mr. BURLEIGH if the range of advantage or disadvantge is greater in the turbine than in the reciprocating engine. That is, would you make a greater loss with an engine running at low pressure, or an engine that was running at less load, we will say, or at great overload?

Mr. CHARLES B. BURLEIGH. I think, perhaps, I can answer the question in the part by stating that the steam curve of a reciprocating engine is a comparatively picked curve. That is to say, the steam consumption rises very rapidly both above and below the designed full load point. On the other hand, the steam curve of the Curtis turbine is much flatter than the engine curve corresponding more nearly to a straight line, showing added efficiency for the turbine the farther the load conditions depart over or under the designed full load point.

The reciprocating engine is not ordinarily capable of maintaining nearly as heavy an overload as is the Curtis turbine. It is seldom that an engine will handle as heavy an overload as load and one-half, that is without increasing its cut-off to the sacrifice of efficiency. That is one of the principle advantages of the Curtis turbine, which becomes more apparent the further we depart from designed full load conditions.

I think it is generally admitted by even turbine people that if an engine could be operated at 100 per cent. load continuously

ten hours per day, a turbine operated under the same conditions would show very little, if any, saving in fuel; but the further you depart from these load conditions the greater the gain shown by the turbine.

Mr. ARTHUR H. LOWE. I meant to consider both conditions, pressure variations as well as load variations.

Mr. CHARLES B. BURLEIGH. Regarding differences of pressure, I think, perhaps, Mr. RICE could answer your inquiry better than I, as he is more familiar with engine conditions.

Mr. RICHARD H. RICE. The Curtis turbine will stand a greater range of conditions, both of pressure and of load than the reciprocating engine, because in the turbine we have no trouble from cylinder condensation, which is the great factor of loss in the engine. Cylinder condensation makes itself apparent in the engine the minute you depart from full load conditions. In the turbine we practically get returns from the steam in proportion to the amount of available energy in the steam. That is to say, if we change our pressure and get higher initial pressure we have more available energy and we realize from that in the turbine almost instantly. The law of change of economy, due to change of steam pressure in the turbine, follows a straight line. When you increase the steam pressure to any great extent in a steam engine you will probably have to add another cylinder to maintain reasonable economy.

The PRESIDENT. What is the comparative first cost for a given amount of power of the two systems?

Mr. CHARLES B. BURLEIGH. This item is governed so largely by local conditions that it is rather difficult to name any fixed percentage of difference. It would be more or less of a guess, but I would say, comparing the turbine complete, including its steam and electric unit, with a reciprocating engine and genera-

tor, to make available its full output of equal economy at full load.

The PRESIDENT. Yes, that is the point.

Mr. CHARLES B. BURLEIGH. (Continuing) The cost of the turbine unit would be from 10 to 15 per cent. less than that of the engine unit. When the auxiliaries, including land, buildings, boilers, pumps, foundations, and other items which go to make up a complete power plant are taken into consideration, the difference is even more in favor of the turbine.

Mr. ARTHUR H. LOWE. I wish to state that my question was suggested by Mr. BURLEIGH'S statement that as I understand, to get the best results from the turbine it should be specially planned and constructed to take a pressure.

Mr. CHARLES B. BURLEIGH. No, not necessarily.

Mr. ARTHUR H. LOWE. Of course, if it was not designed for a special pressure, then the question arose in my mind whether the disadvantage or loss of pressure would offset the advantage.

Mr. CHARLES B. BURLEIGH. The idea I intended to convey was this. That a change in pressure from 150 to 120 pounds would result in a difference in efficiency of about 3 per cent. and that the expense of especially designing the machine for 120 pounds would probably amount to more than the three per cent. saved.

Mr. ARTHUR H. LOWE. Then I would like to ask, supposing you had an engine that was specially designed for 120 pounds pressure and these changes gave you 150 pounds pressure, what is going to be the result?

Mr. CHARLES B. BURLEIGH. Do you refer to the reciprocating engine?

Mr. ARTHUR H. LOWE. No, with a turbine designed for 120 pounds pressure, suppose you should install boilers making 150 pounds available, what will be the result?

Mr. CHARLES B. BURLEIGH. You might expect gain approximately 3 per cent. in steam economy.

Mr. ARTHUR H. LOWE. Well, it would not be a loss?

Mr. CHARLES B. BURLEIGH. No, indeed.

The PRESIDENT. Could you use 150 pounds pressure on a turbine designed for 120?

Mr. CHARLES B. BURLEIGH. Surely, and no injurious effects would result from the use of 200 pounds or over.

Mr. ARTHUR H. LOWE. Yes, but you would lose the advantage or your 150 pounds pressure.

Mr. CHARLES B. BURLEIGH. No, you would gain approximately 3 per cent., as stated. That is to say, by raising your pressure from 120 to 150 pounds you would have improved your economy more with the turbine than you would under the same conditions with the engine.

Mr. HOWARD D. COLMAN. Would it be practical in such a case as that if the change in boiler pressure were of wide range, say from 120 pounds to 200, to put in an additional engine which would practically constitute another stage?

Mr. CHARLES B. BURLEIGH. No.

The PRESIDENT. There is one important point I should like

to see brought out a little more clearly with regard to steam consumption.

As I understand it, in this so-called "whurrlegeeg" type of engine the steam consumption per indicated horse power is under thirteen pounds. How does that compare with the best practice on the so-called "Jeemie Watt" type of engine?

Mr. CHARLES B. BURLEIGH. It is rather difficult to answer your question in specific figures, for the reason that we must base our figure on certain load conditions.

Considering full load conditions, where the turbine shows the least saving over the reciprocating engine, I would refer you to the Lynn test as given on page 216 of the paper. Here we have 15.91 pounds of steam per kilowatt hour. That is equivalent to approximately 10.7 pounds per indicated horse power.

The PRESIDENT. Have you tests as low as that?

Mr. CHARLES B. BURLEIGH. Yes.

The PRESIDENT. Does that beat any reciprocating engine today?

Mr. CHARLES B. BURLEIGH. I am not familiar with any engine figures that can equal them.

The PRESIDENT. Perhaps Mr. RICE could tell us.

The point that at once impresses manufacturers, I think, is the comparative economy in the consumption of steam between the two types of engines. In the test you read on page 209 you speak of 12.9 pounds per indicated horse power.

Mr. CHARLES B. BURLEIGH. Yes, but those were not test figures.

The PRESIDENT. I thought that was your estimate of the best that could be done.

Mr. CHARLES B. BURLEIGH. Oh, no indeed, I simply assumed twenty pounds per kilowatt as being an average guarantee for the purpose of showing the comparison between the kilowatt, electrical horse power, break horse power and indicated horse power figures without any reference to actual test figures.

Mr. RICHARD H. RICE. You figure Mr. BURLEIGH that 15.91 per kilowatt is equal to 10.9 pounds per indicated horse power, do you?

Mr. CHARLES B. BURLEIGH. 10.7 pounds.

Mr. RICHARD H. RICE. I know of no reciprocating engine figures which are equal to that. I should say that about 11.5 to 12 pounds would be the best engine figures under those conditions.

The PRESIDENT. Are these tests reliable for actual practice?

Mr. CHARLES B. BURLEIGH. All tests mentioned in the paper were made by the owners.

Mr. RICHARD H. RICE. I should say it would not have the standing that a test made by a scientific mechanical engineer would have. This test, I understand, was made by the station force. It ought not, therefore, to have the weight of a test made by competent mechanical engineers. But it confirms tests we have made ourselves.

Mr. CHARLES B. BURLEIGH. I wish to say that I could have given you innumerable tests in this paper but have stated in the paper under the head of Steam Consumption on page 207 my reasons for presenting only the figures with which we had not even the remotest connection.

Mr. HOWARD D. COLMAN. I should like to ask Mr. BURLEIGH whether there is greater advantage in the use of super-

heat in connection with the turbine than with the reciprocating engine?

Mr. CHARLES B. BURLEIGH. Yes, and no. The gain in steam consumption per degree of superheat is not widely different in the turbine from the engine but the Curtis turbine is so constructed as will admit of the use of steam of a much higher temperature without inconvenience than will the reciprocating engine. Thus the range of benefit to be derived from superheat is much greater in the turbine than in the engine.

Mr. HOWARD D. COLMAN. That is because of the absence of lubricating oil in the turbine, I suppose?

Mr. CHARLES B. BURLEIGH. Yes, in part. Then again there are no close fits in the Curtis turbine which would be seriously effected by expansion, due to high temperatures, nor are opportunities presented for temperature changes. It is still much of a question, however, with both the turbine and engine as to whether the benefits to be derived from a high degree of superheat are commensurate with the cost of producing it.

Mr. HOWARD D. COLMAN. I should think that owing to the absence of condensation losses in the turbine the advantages to be derived from superheat would not be as great, since one of the principal advantages of superheat is that it eliminates condensation.

Mr. CHARLES B. BURLEIGH. Condensation is the result of radiation, and the turbine presenting less opportunity for radiation benefits from the moving parts, being surrounded by the less dense atmosphere.

The PRESIDENT. The second paper this morning is entitled Practical Experiences in Electrical Driving, by Mr. JOHN A. FERNLEY of New Bedford.

PRACTICAL EXPERIENCES IN ELECTRICAL DRIVING.

JOHN A. FERNLEY, New Bedford, Mass.

There have been so many papers read before this Association on electricity and its advantages in relation to the driving of machinery in mills, that it almost seems as if the subject was one on which little more of interest could be said; more especially so, after the papers read by Messrs. PAINE and THOMAS, as both these gentlemen are recognized as authorities on this subject; and Mr. THOMAS, in the paper which he read before you on September 22, 1904, gave a list of the many papers which have been read before this Association on electricity suggesting that a perusal of them would prove profitable, and I endorse this suggestion.

There is no doubt that the advantages to be derived from an electrical drive have been ably and fully set forth, and if any one has a desire to know what they are, I would advise the reading of a paper given by Mr. PAINE before the British Association of Managers of Textile Works, at Manchester, England, on August 9th, 1904, and which has been published in pamphlet form by the General Electric Company. Still, after all, none of the papers that I have read have referred in any way to any disadvantage that may or may not be found in electricity as a motive power or to the trouble that may at any time arise through its use.

The papers have always been more or less of a technical nature and have been following each other on a rather one-sided study, namely: the desirability of installing an electric drive and the opportunity it presents to determine the horse-power that is being used by the different departments or

machines; while the question of the practical points that are continually presenting themselves to the mill manager or superintendent has been rather lost sight of.

I do not think that anyone today seriously doubts that electrical driving has many advantages over either the rope or belt drive, and certainly the writer's experience has proved that they are neither few nor small, still, on the other hand, there are many people who think that its advantages are offset by its cost of installation, etc., coupled with a vague suspicion that it is not thoroughly understood, and is apt to cause a greater amount of trouble than either the belt or rope drive; and so conclude to stick to the old methods; while others who are satisfied as to its advantages as given by its advocates and friends, want to know what the results are in actual working, and whether it can be handled with success in an ordinary cotton mill, stating that while they are convinced of its advantages in general, they want to be enlightened as to its every day working. As one practical engineer said to me sometime ago, "If I could only *see* what it is and be *sure* of what the result would be, I would feel more satisfied with its installation." This remark simply goes to show that the average mill man is rather afraid of a force which is invisible to him and the component parts of which he is unable to comprehend.

To be able to clearly understand and give full consideration to the arguments for or against an electric drive, we must keep in mind the fact that electricity is not a primary energy, but merely a secondary power that depends upon a mechanical plant to generate it. Coal must be used to develop the mechanical energy before the electricity is generated and therefore, there is no advantage in this respect, the cost being about the same for the production of a horse-power in either system, the difference being, that in one case the power has to be carried to its destination by a series of belts, thus providing one large unit from which all the subdivisions derive their power; while in the other it is developed into electricity and by wires carried to the switch board (a part of which is shown in figure 1)

for distribution around the mill and then subdivided into many units of different capacity, each one of which is entirely independent from the others and can be controlled either in the mill or engine room, without interfering with the operation of any of the other units.

These units are known as "Induction Motors," and are simply a machine used to change the electrical into the mechanical energy, and depend upon the amount of electricity as expressed in volts and amperes, for their efficiency.

Thus we find that a double process is required in electrical driving before the energy is at the point where it can be used and between the changing of the steam power into electricity, and its conversion back into mechanical energy by the motor, there is quite a loss of power.

When a motor is built it is wired and wound to perform a certain amount of work and is in two parts, termed the "armature" and "field". The field is charged with the electricity from the generator and as a result the armature is made to revolve and thus operate the shafting. The higher the load, the more resistance there is to the action of the electricity and this produces a loss of speed which in some cases reaches as high as three per cent. between the full load and no load speeds. It will be readily seen that if the full current was thrown into the field at the starting of the motor, it would have to start at its highest velocity, owing to the fact that the load would be at its lowest point and this, of course, is something no machine could stand. To get over this difficulty, in each motor is placed what are known as "resistance" grids, the functions of which are to take some of the electricity away from the motors and thus enable them to be started at a sufficiently low speed, and after a few seconds these grids are gradually cut out or short-circuited and the motor brought up to its full speed.

It is right at this point where one is apt to find out that there is more to the successful running of an electric plant than appears on the surface of things and where experience comes in to teach many lessons. In the first place it is necessary that

someone shall be responsible for the starting up of the motors and this means one or more persons in each room. I notice Mr. MERRILL in his paper read before this Association at the spring meeting of 1905, stated that "In some cases, all the motors on one floor are arranged to be controlled from the same station, thus allowing one operator to start quickly, the entire department." It is clearly impossible for one person to do this and yet preserve the individuality of the different units and to destroy this individuality would take away one of the principal advantages that electricity has over any other kind of drive.

The employment of so many different people in the starting of the motors involves danger from the fact that upon the way in which the work is done, depends the whole power of that particular unit, for should the electricity be switched on with the resistance out, the motor is apt to be put out of commission, while on the other hand if the resistance is left in too

FIGURE 1.—MOTOR AND SWITCHBOARD.

long they are liable to become overheated and weakened with the result of the loss of that unit of power until repairs can be made. These repairs may be of such nature that the electrician in charge of the plant may remedy the trouble by taking out the old grids and substituting a new set, or they may be serious enough to call for work upon the motor itself, in which case the nearest point for repairs is Schenectady, New York, and involves a loss of from four to eight weeks before the machinery at that point can be operated again.

This is a very serious matter when it occurs and with so many persons in charge of the motors is ever present. If you will refer to figure 1, you will notice a lever marked *A*, at the left, which controls the resistance grids and when the motor is placed on the ceiling must be worked with a long pole, care being taken to be sure that the resistance is either entirely in or out as the case may be.

I know of several different cases where trouble has occurred, in one instance, the grids were burnt out before the mill had been running very long and before the officials were aware of the desirability of having spare sets on hand, with the result that the machinery was stopped until a set could be made for this particular motor, which, with the time taken up by transportation, etc., took up quite a long time. The only safe course is to have a complete set on hand for the different horse-power motors and where a mill is equiped with machines ranging from 10 to 200 horse-power, it means a large outlay for supplies that may never be used, but which should be obtained when the motors are installed, so as to forestall any difficulty that may arise should they give out.

The next of importance in the motor is the "Air-gap" or the space that is left between the revolving armature and the stationary field. This space is made as narrow as possible owing to the fact that the permeability of air is very low, and therefore, the smaller the space that the current has to cross, the greater the efficiency of the motor. If you will again turn to figure 1, you will see that the casing of the motor is left open at the ends.

This is done for several reasons, one of which is the fact that the efficiency of the motor decreases as the temperature increases, so that the cooler the air in the motor is, the better work will the motor do.

It will readily be seen that in a room where there is a large amount of dust and cotton fibres in the air, such as is found in card rooms, etc., that this air gap will soon become more or less filled with the same, and thus in a measure insulate the field from the armature and give the current an added resistance to overcome before doing the work of operating the machinery.

To overcome this it is necessary to have the motors thoroughly cleaned out, by blowing out this accumulation of dust and dirt. The time between such "blowing off" depends entirely upon where the position of the motor is, but I incline to the idea of giving it a good cleaning at certain stated intervals rather than to simply clean it a little every day.

About the only effectual way to get this lint and dust from the interior of the motor is to install a compressed air system; the pump for which may be placed in the engine room basement or other convenient place, and to carry this air by means of pipes to every motor in the mill, placing a valve on each side of the motor, as shown in figure 1 and next to the wall, marked *B*. Select some man to attend to this work in the different rooms and provide him with about six feet of very strong rubber hose, capable of withstanding a pressure of about fifty-five pounds. Have it understood that the air must be applied to each side of the motor more than once, blowing from one side and then the other alternately. The reason for this is because there are so many crevices and angles in a motor that blowing from one side alone would only distribute the cotton dust around the inside of the motor.

Then the electrician should go over the motors and inspect them, testing them with the gap guage to see that there is no danger of the armature touching the field.

This test should be carried out often, for upon it depends the very life of the motor. As stated earlier in this paper, for

plain reasons the motors are made with the air gap as small as possible; and should the armature through any cause move out of its proper position, it would come in contact with the field and thus burn out the motor. This, of course, is something that may never occur, but any person knows that bearings are apt to become overheated and melt or even to gradually wear away, unless properly attented to. This danger the gap guage is a preventative for; but in the case of overheating, the trouble sometimes develops very rapidly, and before preventative measures can be taken, the damage is done.

I had a personal experience along this line which illustrates this point and at the same time shows the seriousness of the trouble.

By turning to figure 1 again, you will notice the small drip-cock marked *C*. In some unaccountable way, this drip on one of the motors that runs the looms was opened and thus allowed all the oil to leave the bearings. The result was a hot bearing, a short-circuited motor, and a stoppage of that particular motor for a period of six weeks, owing to the fact that the motor had to be taken down and shipped to Schenectady, to be re-wound. This is not an isolated case, for at the time of writing I know of one mill that has had an armature away from the mill for about three months. Take these cases in connection with the fact that the motor is an independent unit and that the power cannot be utilized in any other way, and it is easy to see how annoying and serious these breakdowns are.

There is another item which may be worth a brief reference in this paper and that because of the annoyance which is caused thereby. If you will recall I stated that there is a loss of speed between the no load and full load of a motor. This is claimed by the electric people to amount to about two per cent. but I have found it to exceed that amount in some cases. In the mule room this difference shows itself more than in any other department of a mill, owing to the fact that the load is so variable. If you will turn to Figure 7, you will be able to form a fair idea of how great this variation is. The chart was taken

from a motor that was operating six pairs of mules, with a total of 9,800 spindles. It will readily be seen that at some points the load on the motor is very low, thus increasing the speed, while at other times it is overloaded, with a consequent loss of speed. These changes are caused by the difference in the amount of power required to operate a mule in its various operations and where the mules are on different numbers of yarn, cannot be avoided. The result of these variations of speed on the quality of the work soon shows itself, both in kinks and other troubles and the only help I have been able to find is in substituting a larger belt, so as to overcome the loss as much as possible.

No doubt some of the members present remember an argument which arose at the spring meeting in 1904, wherein Mr. THOMAS sought to combat the opinion expressed in a paper just read by Mr. GREENE, that one of the troubles of an electric installation would arise from the fact that the machines would soon become obsolete owing to new designs. Mr. THOMAS thought that such would not be a fact, but if you will turn to figure 2 and compare the motor there shown with the one on figure 1, you will readily see the difference between a motor installed less than four years ago, and one put in six months ago. There is no doubt about the fact that the later motors are a great improvement over the earlier ones, but every new type means an added expense in the way of supplies, owing to the fact that the grids, bearings, etc., are different. In the motor shown in figure 2, there are several improvements to be found, especially in the position and make of the resistance grids, which in this case are in the open, thus being easy to get at, and they are so constructed that sparking is to a great extent done away with, while in the other motor they are cased up and placed in a position in the motor which is very inconvenient.

Coming back to the generator, we are confronted with a machine which has certain advantages over the belt drive but which has also some disadvantages. There is no question but

FIGURE 2.—CEILING MOTOR.

that where a mill plant is overloaded to any great extent, that electricity is preferable to belts, from the fact that a belt will only carry a certain load, no matter what the capacity of the engine, while in the case of a generator you can carry up to 40 per cent. of an overload and this at a very small loss in comparison to belts. This is an advantage which most especially applies to mills which are run by two engines and generators, both being run together as one unit, from the fact that if one engine or generator is disabled, it is possible to throw a large proportion of the whole load upon the remaining generator, thus cutting down the loss to some extent, while with a belt drive the loss of the engine would be total. Still, even at this point there are possibilities of accidents that may occur which are not found in a mechanical drive.

Before it is possible to obtain any power from the generator,

it is necessary to charge the field with a current of electricity, thus producing a residual magnetism, from which the machine is built up. Should the "Steam exciter" in any way become useless, it would mean a total suspension, because no power could be generated; so that we have an added point of danger which is not present in an ordinary drive. After the generator has built up to its rated voltage, the current is switched into the machine shown in figure 1, and this motor is used for the purpose of keeping the field excited. Should the motor fail to do its work, an instant shutdown is the result, with possibilities of the engine running away which can be imagined. I have had one such case, caused by the poles on the motor becoming reversed, but we started up the steam exciter and ran in this way until the motor was fixed.

Another experience which I have had recently was the burning out of a number of pole pieces or coils, in one of the gen-

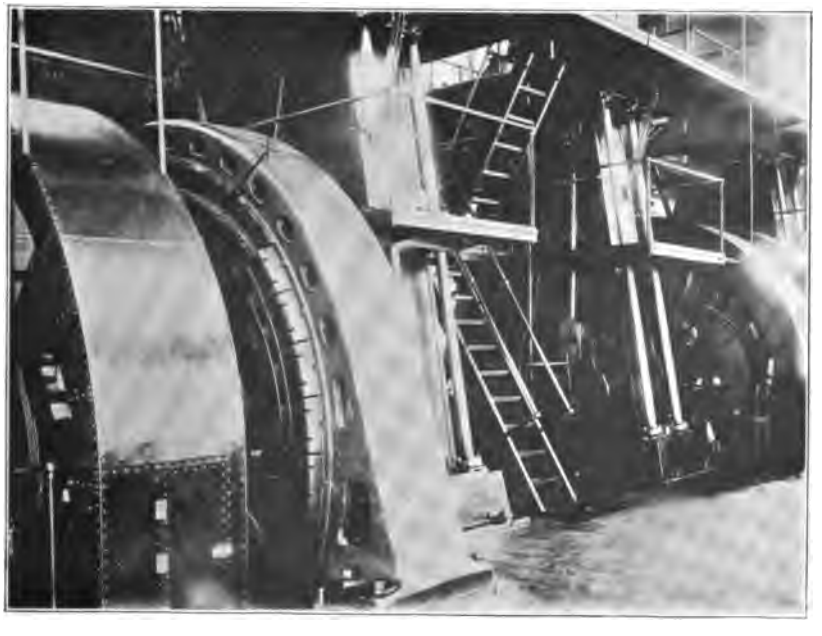


FIGURE 3.—GENERATOR AND STEAM ENGINE.

erator armatures. The engines seemingly were running with their usual smoothness and were carrying a load *under* their rated capacity. The generator was apparently all right, when about eight o'clock in the morning, a noise resembling somewhat the roar of a cannon came from the engine room. As soon as possible the engines were shut down, but it was impossible to find out at first what the trouble was, owing to the room being filled with smoke, but eventually it was found that a large hole had been burnt through the coils, and that the solid iron casing had been burned away. Apparently, there was no cause for the accident, except that it might have resulted from an imperfectly insulated coil.

Figure 3 is from a photograph taken soon after the accident occurred and the point where it was burned out is marked by an ×.

Owing to the fact that such an accident had not been expected, no spare coils were at the mill, and on telephoning after some, it was found that there were none at the works at Schenectady, thus giving us the rather unpleasant prospect of a shutdown until these coils could be made and shipped to the mill. We finally decided to endeavor to make some temporary coils in our machine shop, and see what we could do to get the machine running. It was rather a doubtful chance, but fortunately it was successful, and we were able to start up after a shut down of two days and a half. Had we had to wait for the coils from the works, it would have meant at least three weeks before we could have run. The lesson to be taken from this case, is to keep a supply of almost all parts on hand, rather than to depend on the works, even although they may never be used.

Apart from such troubles as these, there is no doubt but that electrical driving is advantageous, and in a large plant, more economical, than the mechanical. It is very flexible and requires a minimum amount of shafting.

Figures 4 and 5 are views of the mule and frame spinning rooms, and give a good illustration of this fact, In the spinning room

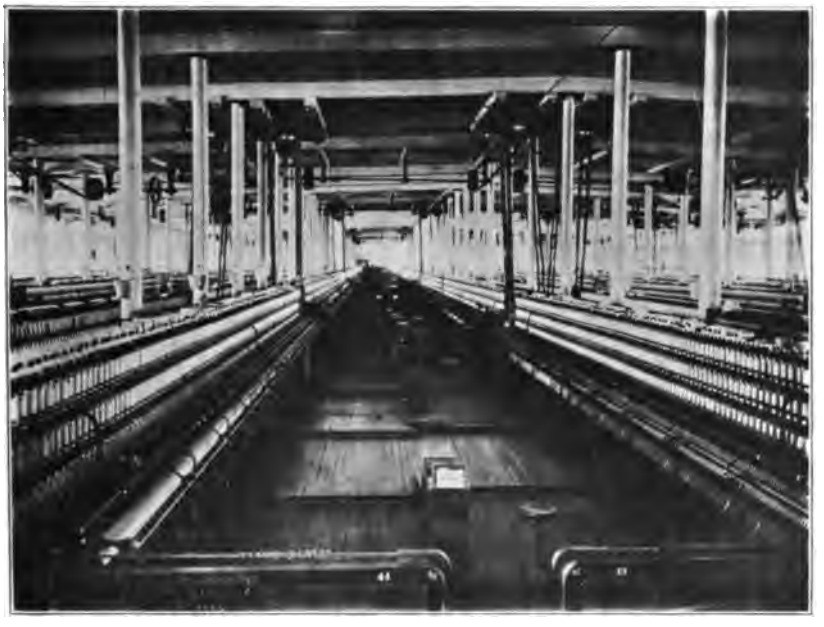


FIGURE 4.—MULE SPINNING ROOM.

FIGURE 2.—FRAME SPINNING ROOM.

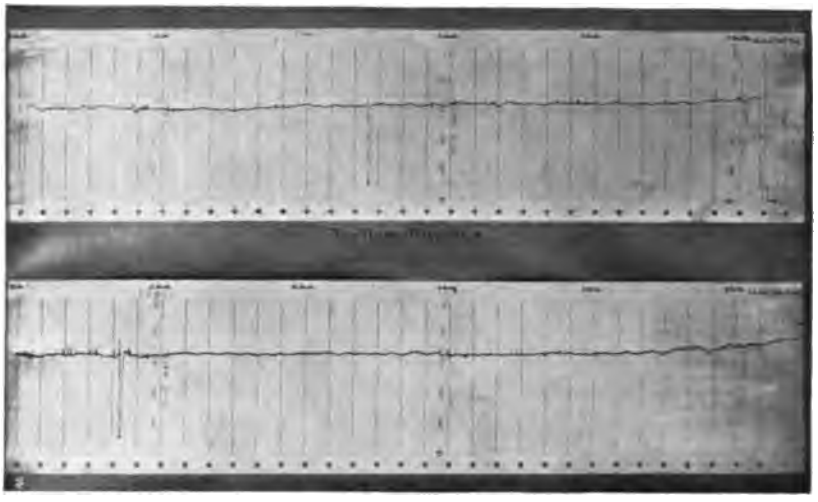


FIGURE 6.—POWER CHART.

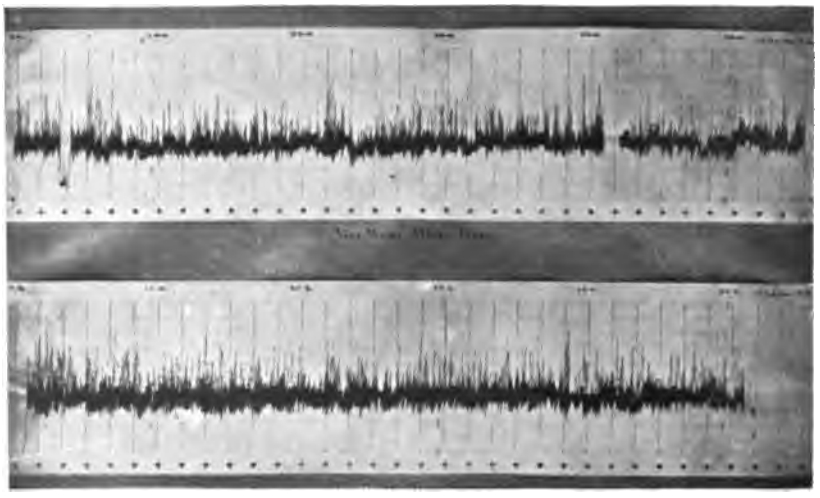


FIGURE 7.—POWER CHART.

the motors are directly connected with the shaft by flexible couplings a view of which may be seen in figure 2.

In reference to the amount of power used, there seems to be but little difference in the loss on an electrical and mechanical drive, as far as getting it to the room is concerned but there is a decided advantage in favor of electricity after it reaches the motor. In any room but the mule room, the drive is more even and gives better results. Figure 6 shows a power chart taken on a motor running 11,264 spindles, and shows the result of one full day's work. This motor for one week averaged between 72 and 73 spindles per horse-powers, including the shafting and at the present time is over 75 spindles per horse-power and with the shafting deducted almost 100 spindles per horse-power.

I have purposely refrained from taking up the question of

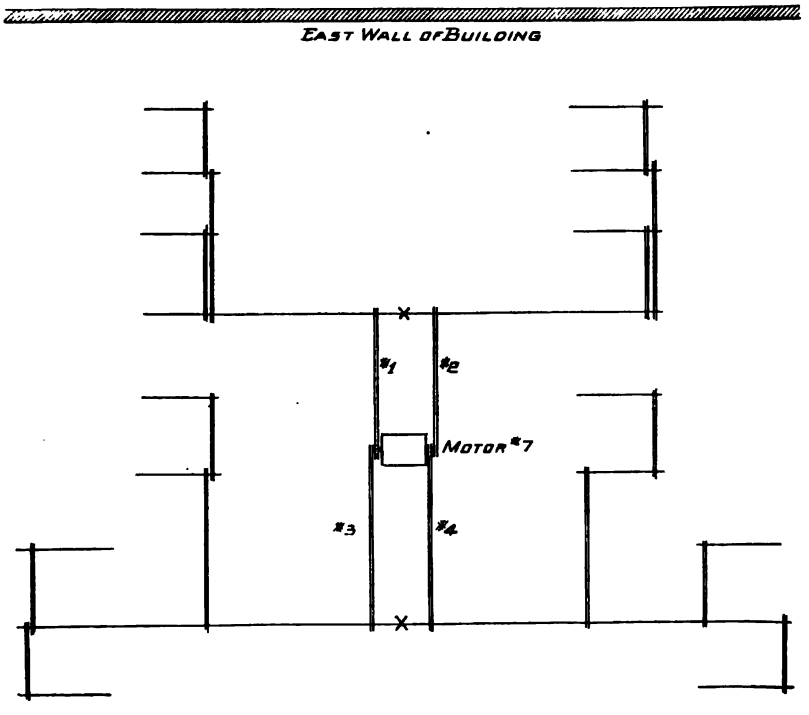


FIGURE 8.—DIAGRAM OF BELTS CONNECTING SHAFTING AND MOTORS.

power because it has been thoroughly gone into by others, but I wish to state that I am satisfied that a large motor is more economical and satisfactory than small ones, although not quite so convenient.

Before closing, I want to call your attention to a point in the mechanical arrangement of pulleys on motors that is worth noting. By turning to Figure 8 you will notice that the motor is carrying two belts to each line of shaft. We tested the friction load with all four belts and then took off No. 2 and No. 3, and the result showed conclusively that two belts took less power than four. Presumably from the fact that one belt is a little tighter than the other or perhaps one of the pulleys being a trifle larger than its mate, thus forcing it to do all the driving and also take care of the friction caused by the lagging behind of the other belt. If the two lines of shafting were cut where the chart is marked by an ×, it would no doubt end the loss of power at this point.

Mr. WILLIAM D. HARTSHORNE. This is a very interesting paper and shows the importance of a thorough understanding of electrical machinery before undertaking to operate it. The points brought up are certainly of importance and ought to be carefully considered. For a matter of information I would like, before preceeding farther, to ask if the speaker has any comparison in regard to the ratio of repairs for motors compared with a corresponding mechanical drive.

Mr. JOHN A. FERNLEY. I have no data here, but my experience has been that repairs are less in electrical driving than in mechanical.

Mr. WILLIAM D. HARTSHORNE. And again may I ask, about how many motors have you in use?

Mr. JOHN A. FERNLEY. Twenty-two.

Mr. WILLIAM D. HARTSHORNE. That is a good number to get experience from. The point that I had in mind in speaking of repairs was that I had so far in my own experience no data to go upon beyond the fact that it appears to be so extremely small with the electrical unit that it seems hardly worth while to make the comparison.

Mr. JOHN A. FERNLEY. That is true.

Mr. WILLIAM D. HARTSHORNE. I think we have sent back two motors to the factory since we have had electrical power. One of them was sent back for a cause which we did not determine, and I am not sure that the factory did, where the field came in contact with the rotor. But that was really the case before we began to use the motor and probably was due to some imperfection in putting it up. The only other case was where an operative without proper authority undertook to start up the motor with the resistance out, as you have explained. Of course that is fatal, and it is just as fatal as for an engineer to allow his vacuum to suck over water into the cylinder; he will push out the cylinder head, most assuredly. All those points are important, of course, and should be clearly understood. But such chances of accident seem to me in a matter of relationship to be comparatively small if the mill is properly conducted when compared with the dangers which are unforeseen in a way in mechanical drives. The question of relationship of the mechanical drive to the electrical drive is certainly a very important one and I do not know that we have ever had any papers that have gone into the matter as thoroughly as time will eventually develop.

Mr. FREDERIC W. HOWE. Some points occur to me on

which I would like information. I understand in many mills where the electric drive is used, it is customary, probably due to the first cost, to divide the motors, these independent units, into different capacities, some rooms requiring larger motors than others, and the first cost, of course, being reduced by getting the sizes of the motors as nearly proportionate to the needs of the room as possible. Obviously this would necessitate, to save delays from shutdowns, the carrying in stock of a large number of resistance grids and other parts or the carrying of duplicate motors, which would be practically impossible owing to the number. I would like to inquire from Mr. FERNLEY if he thinks that that method of equipping a mill with motors is better than to divide the load into equal units with motors of 100 or 200 horse power, some of which would be of course larger than required, and then in a room where 500 horse power was required, using five 100 horse power motors, and then carrying in stock, besides certain repair parts, perhaps one complete motor, so that in case of a shutdown there would be but a temporary delay.

Mr. JOHN A. FERNLEY. To do that, of course, would destroy one of the great advantages of the electric drive. There is no doubt it would be a perfect thing, as a gentleman said to me in relation to the electric drive when I was taking him through the mill. He wanted to know why we could not have every motor 200 horse power or 100 horse power and then keep one complete motor on hand to forestall any difficulty. Of course we know that one trouble would be that we should not subdivide it sufficiently. For instance in the electric drive you can run your shafting for your cards the length of the mill and for your sliver lap machines you can run the shafting across the mill and you can put the combers in any corner you wish, and in that way you can arrange your machinery to far greater advantage with relation to electrical units, small and large, than you can with a mechanical drive, and without any loss of power aside from the usual loss in electrical transmission.

Mr. D. W. GRAY. I would like to ask Mr. FERNLEY what in his judgment, is the cost of maintainence and repairs in a mill electrically driven compared with the mechanically driven mill?

Mr. JOHN A. FERNLEY. Mr. HARTSHORNE asked that same question; I think he answered it himself. Mr. HARTSHORNE is in the electrical business just as well as I am. We find, (I find he agrees with me), that there is hardly any comparison; that the repairs in an electrically driven mill amount to so little that we cannot get enough to make a comparison on. We have been running nearly four years and our repairs, outside of these things that I have given you, have been so small that they are not worth referring to.

Mr. GEORGE A. AYER. I missed a part of the reading of Mr. FERNLEY'S paper, but I have made a few notes here of questions I want to ask. Possibly I may betray ignorance; certainly I am ignorant on the subject. The first question has practically been answered, that is, "Is the electric drive of more trouble than the rope or belt drive?"

Mr. JOHN A. FERNLEY. No.

Mr. GEORGE A. AYER. Mr. FERNLEY says: "Coal must be used to develop the mechanical energy before the electricity is generated; therefore there is no advantage in this respect, the cost being about the same for the production of a horse power in either system." I have somehow got the idea that the cost of the electrical drive is greater. Am I wrong?

Mr. JOHN A. FERNLEY. It is a hard question to answer. There are so many different mills with different systems of belt driving that it is hard to get a comparative test of the coal consumption. But I am perfectly satisfied to give any gentleman, I don't know that I care to give it publicly, but I will give any gentleman privately, the pounds of coal per horse power hour that we are using in our mill. We are running a little over

100,000 spindles at the present time. I think I am using less coal per horse power hour than the majority and I dare say the great majority of the mills that I know of.

Mr. GEORGE A. AYER. Farther along in the paper I find on page 254: "Between the changing of the steam power into electricity and its conversion back into mechanical energy by the motor, there is quite a loss of power." That would probably mean extra cost, would it not?

Mr. JOHN A. FERNLEY. That I refer to again, Mr. AYER, farther along and state that the loss of power is not as great as it is in the mechanical drive. I have talked with people who seemed to think that there is no loss of power in the electrical drive. Mr. PAINE possibly can give you that better than I can, but I should say that you lose approximately 20 to 22 per cent. from your engine to your machine. You lose about nine per cent., of course, as I say, different plants differ, but you lose eight to ten per cent. between your generator and your switchboard. The rest of it is in the wiring and motors in the mill.

Mr. GEORGE A. AYER. Another point is in the starting of the motors. It seems to be impracticable for one party to start them all. In a previous paper I noticed the phrase "fool-proof" was used, and it is very pat. We would like to get something that is fool-proof. I would like to inquire if it is not practical to have a motor placed on a machine, or at some part of the mill, that is practically fool-proof. The motor spoken of here apparently has a graded starting device similar to an electric car. Is it not practical to have a motor so simple that you can start or stop, throwing the switch on or off, as you would throw the shipper on or off in a belt driven machine.

Mr. JOHN A. FERNLEY. From what experience I have of the electric drive I do not see where you can do so, because, as I said in the paper, the shafting or the motor would have to start up at its full velocity at the instant the electricity was put

into the field. Therefore, take a motor at 800 revolutions per minute, you can imagine what it will mean if you put 550 volts into that machine at the instant. It would pull the shafting down, I suppose.

Mr. WILLIAM D. HARTSHORNE. I do not know that there are many machines that can be said to be fool-proof, but possibly the latest type of motor made by the General Electric Company, of which we have recently put in some, is as near that as may be where this particular form of putting in the resistance is changed and in such a way that it is automatic. I am not familiar enough with it to describe it, but possibly someone from the General Electric Company can do so to greater advantage.

The PRESIDENT. Mr. SMITH, I think —

Mr. ABBOTT P. SMITH. I was going to ask Mr. FERNLEY whether or not he thought the speed of the electric drive was more constant and whether or not he got a greater production with the electric power than with mechanical.

Mr. JOHN A. FERNLEY. I would say, gentlemen, that my experience is, as briefly referred to in this paper, that outside of one or two points my speed is more even, and naturally, of course, the production is better from electricity than from the mechanical drive, both in the spinning room and in the card room, but in the mule room there are certain disadvantages that offset that to some extent.

Mr. GEORGE A. AYER. I would ask if a motor is made that you can start up as you would shift a belt from a loose to a tight pulley.

Mr. JOHN A. FERNLEY. I will let Mr. PAINE answer that.

Mr. SIDNEY B. PAINE. I would answer Mr. AYER'S previous

question by saying that there is no motor made that is fool-proof. I do not know of any motor of large size that it is practicable to start by the simple throwing of a switch. It is possible to do that, but the rush of current would be so great as to disarrange the entire system. That question involves the discussion as to the different types of motors, and I should prefer not to enter into it at this time, as it is pretty late. It is a very broad question and there are many sides to look at, but I think that the motor that he refers to would not be practical in a mill, if that motor were of large size.

Mr. JAMES O. SWEET. The question that I propose to ask may have been answered many times in your previous meetings which I have not attended and I profess to know but very little about electricity. But I wish to give a problem simply to know what would be the loss of power in the transmission of electricity a certain distance. For instance, suppose you have a place with water power available, where by the kind of a water wheel you can produce 500 horse power. Suppose you instal a dynamo, but you wish to use the power two and one half miles away. Now, if you can produce 500 horse power at the location of the water power and the dynamo, what would be the percentage of loss of power in transmitting it two and one half miles?

The PRESIDENT. I think Mr. PAINE can answer that question better than anybody else here.

Mr. SIDNEY B. PAINE. That question has been asked in previous meetings and an attempt has been made to show that a loss of power on the transmission line is entirely an arbitrary quantity. If the value of the power is great, or if it is desired to utilize it to its utmost, then we can afford to put in a larger copper wire and lose less current in the wire. If, on the other hand, the power is not to be utilized to its full extent or is not costly in its generation, we can afford to lose more on the wire and so use a smaller wire. The percentage of loss in the trans-

mission line itself, therefore, might vary from two per cent. to five or ten per cent., and it might be more economical to use a wire giving ten per cent. loss under certain conditions than one giving even a two per cent. loss. Let us assume, however, that the loss in the wire was fixed at two per cent. You would have a loss in a direct connected generator of possibly six per cent. You would lose two per cent. in your wire, bringing it down to 92.12 per cent. delivered to the motor. You would lose possibly ten per cent. in your motor (if it was a large motor,) bringing the ratio of the power delivered by the motor as compared to that delivered by the water wheel to the generator, of about 82 per cent.

Mr. JAMES O. SWEET. About how much?

Mr. SIDNEY B. PAINE. Eighty-two per cent.

Mr. JAMES O. SWEET. A loss of power?

Mr. SIDNEY B. PAINE. No, I say the ratio.

Mr. JAMES O. SWEET. O, the ratio?

Mr. SIDNEY B. PAINE. Yes; that is to say, the motor will deliver approximately 82 per cent. at two miles distant of the power delivered by that water wheel to the generator.

Mr. JAMES O. SWEET. Then, if I understand the gentleman, in order to produce the largest amount of power which can be produced by a 500 horse power water power, it is simply a matter of difference of the cost or size of the wire? Then if you used the largest wire that is necessary, whatever it costs, what would be the percentage then of loss?

Mr. SIDNEY B. PAINE. I do not quite understand.

Mr. JAMES O. SWEET. If you wanted to get all the power you could.

Mr. SIDNEY B. PAINE. I think that the case that I assumed was about as far as you would go practically, and that approximately 82 per cent. of the power delivered to the generator would be as much as you could expect under ordinary conditions to recover at the motor.

Mr. GEORGE A. AYER. The further question that I wished to ask was the number of motors it is practicable or economical to instal in the plant. In other words, if I understand Mr. FERNLEY'S conditions fairly well, his motors are connected directly to his shafting.

Mr. JOHN A. FERNLEY. Only in the spinning room.

Mr. GEORGE A. AYER. Only in the spinning room. But he has a general group of motors and uses belts for the smaller transmission. Now how far is it practicable to go in this line? Shall we abolish shafting altogether and connect the motors directly to the machines? How far can we go?

Mr. JOHN A. FERNLEY. Of course there is no limit. In our mill we have a 200 horse power.

Mr. GEORGE A. AYER. With economy?

Mr. JOHN A. FERNLEY. As I said, the smaller the motors the less economical they are and the less advantageous. I prefer large motors outside of the fact that you are doing away with one of the advantages, of the electric drive that of utilizing the small units. Take the card room, for instance; I have seven machines in my card room of different capacities, from 25 horse power up to 150. I have a motor on the cards, another on the drawing frame, another on the sliver, another on the pickers, etc.

Mr. GEORGE A. AYER. Do you consider it practical or desirable to put a separate motor on each machine?

Mr. JOHN A. FERNLEY. That is being done in some mills; I am not quite sure where.

Mr. GEORGE A. AYER. I have one more memorandum: Speaking of repairs, Mr. FERNLEY says, page 257: " . . . or they may be serious enough to call for work upon the motor itself, in which case the nearest point for repairs is Schenectady, New York, and involves a loss of from four to eight weeks before the machinery at that point can be operated again." Do we understand that we must have a complete duplicate set of machinery or shut down our plant six to eight weeks for repairs?

Mr. JOHN A. FERNLEY. That is one of the points that I wished to emphasize in my paper. While I am on my feet I want to explain that my paper was not a criticism of electricity as a unit; it was simply trying to bring forward some of these points that might be of use to some of you gentlemen at some future time. As I state in my paper, in one case the drip-cock on a motor was opened in some way and all the oil was allowed to leave the bearings. The result was that in about fifteen minutes, before we knew there was anything the matter with it, the armature came in contact with the field and we had a burned out motor. In such a case, there is no possible way to fix the motor except sending it to be rewound. A gentleman said to me only a few weeks ago, " I should have the motors all one size and keep one motor free in case of emergency." But if you do that you do away with the inequality of the different units and lose one of the greatest advantages. There are repairs that cannot be done in the mill, but of course if that motor is out of commission you can take that power to any other point. You can take the electrical power, but you could not belt it there, but at the same time the machines operated by the disabled motors would have to stop until the motor was repaired.

Mr. THOMAS ARMSTRONG. Mr. President, Mr. AYER asked if it was possible to apply a motor to each machine. In Paw-

tucket, R. I., the Royal Weaving Company, of which Mr. JOSEPH OTT is agent, have their looms operated each by a separate motor. Perhaps Mr. AYER could get all the information he would require from Mr. OTT.

Mr. ABBOTT P. SMITH. Mr. FERNLEY very frankly showed up the disadvantages of the electric drive. Now I would like to know at the present time, after four years experience with the electric drive, whether or not, if he were building a mill today, he would use an electrical or mechanical drive? [Laughter.]

Mr. JOHN A. FERNLEY. That is a hard question. The reason I have shown the disadvantages is because the advantages have been shown up previously; we have heard nothing about the disadvantages and I thought it was time we had something on that side. But I would say, gentlemen, in all fairness, that my experience with electric driving has been such that if today I had the handling of a power installation I should put in the electric drive.

Mr. ARTHUR H. LOWE. This paper has been very interesting and valuable to us who are interested in the electric drive. It seems to me that the discussion since the paper has been read has eliminated about all the troubles except one, and that one Mr. FERNLEY has emphasized, and I think it is a very serious matter if we are to leave this meeting with the impression that it is going to take from six to eight weeks to get these parts repaired, and I think Mr. PAINE ought to defend the General Electric here to some extent in that respect. [Laughter.] We may have the best kind of a machine, but if it is going to take from six to eight weeks to get it repaired we ought to know that, then we will know something about furnishing the mill with the supplies that have been talked about. It seems to me that that is really the most important and the most serious objection that has been brought against the electric drive. I would like to have Mr. PAINE tell us what arrangement he is

going to make or the General Electric Company propose to make to protect us against accidents of that kind, and whether we may expect to have our repairs promptly done or otherwise.

Mr. SIDNEY B. PAINE. I can only say this: that the occasions when it will be necessary to send the entire motor to Schenectady or to the factory, are exceedingly rare. The difficulties which Mr. FERNLEY has mentioned in connection with the starting arrangements are entirely overcome by the automatic switch. This automatic switch will open if the load exceeds a certain predetermined amount. The switch will open automatically if the voltage or electrical pressure drops below a certain predetermined amount. The necessity for that is that as the voltage or electrical pressure drops the quantity of current must increase, and that would unduly heat the motor. The same automatic switch is arranged with a device called the "trip free from the hand," so that if it is attempted to start the motor with the resistance in an improper position the operator cannot close the switch. It comes the nearest to meeting Mr. AYER'S desire of anything that I know of in that respect — it is almost fool-proof. Again, the newly designed motor which Mr. FERNLEY has spoken of removes almost entirely the troubles which he has had, as he stated in his paper. There is practically no sparking at the commutator. Of course, if dirt is allowed to accumulate, as in any well regulated mill it would not be, there might be sparking; but it would take a good while to have sufficient dirt to accumulate to make the sparking.

There is another point while I am on my feet of which I would like to speak. The accident to these grids does not of necessity shut down the motor or stop the room, for any length of time at all. The connections can be made behind the grid and that motor can be started up with the engine. That has been done in a few cases where this accident has occurred, and then the repair parts have come from the factory, and on Saturday afternoon they have been inserted. There has been no time lost on account of the burning out of those grids alone. The entire

cost of a set of spare grids for the Butler Mill would be $137.50, which is not a very heavy percentage on the cost of that plant, which is good for 2,400 horse power.

While I have the opportunity, Mr. President, may I refer to one or two other matters in connection with this paper? I will cut out a good deal that I had intended to say, as it would be unfair to the paper which is to follow. I want particularly to speak of this question of speed. Mr. FERNLEY has spoken about the full load speed and the variations in power between full load and no load. I think that you want to remember that "full load" means rated load; not the maximum load which is on the motor. Mr. FERNLEY has spoken about the difficulties in the mule room on account of this variation in speed between no load and full load. These variations occur between 50 per cent. load and 150 per cent. load, and not between no load and full load. The pulleys on all the shafting and motors when the plant is first installed should be calculated for rated load speed, and not for the no load speed, for the reason that when there is no load on the motor there is no manufacturing going on and we care practically nothing about the no load speed. The motors should be so selected in size as to carry from three quarters of the full load to full rated load under normal conditions. For those reasons the variation in speed would be less than one half of one per cent., which is pretty hard to determine with a motor running 600 revolutions with any tachometer that is made, even the best. I call attention to that for the reason that oftentimes the pulleys are based on the motors running on the no load speed, which is entirely incorrect.

Referring to this question of speed, however, Mr. FERNLEY has not seen the second series of tests which were made on his mill, because they were not compiled at the time when he wrote his paper. The variations in speed in the mule room were found on the first test to be from 595 maximum speed to 580 minimum speed. But the engine was 45 per cent. over loaded during that test and the engine itself varied from 134 to 130

revolutions. If the engine had maintained its speed the motor would not have varied two revolutions between maximum and minimum loads. This is proved by the second test which was made on that same motor under identical conditions with a generator and engine not running beyond its rated load. The engine ran at 134 revolutions for half a day with practically no variation. The maximum range in speed on that same motor was from 595 to 596, proving that the variations which Mr. FERNLEY complained about were due not to the motor but to the engine, and due to the engine because it was so extremely overloaded. I think that that shows pretty clearly the regulation in speed of the motor, and in justice to Mr. FERNLEY I would say that he did not know the results of this second test, as we had not compiled the figures.

In regard to this accident on the generator I want to say this: that it is the first and the only case which I have known in the fourteen years that I have been engaged in this work where a generator of this type has burned out where it was directly connected to an engine, and I cannot imagine a more disastrous burn-out than that which happened on Mr. FERNLEY'S generator at that time. But what was the result? The shut-down of two days and a half that he speaks of was not two days and a half for the *whole mill.* They had two generators. It was not two days and a half for half the mill, because he threw as much of his load as possible — as much as the engine would carry — on to the first generator and carried more than forty per cent. overload, I think, on that first generator.

Mr. JOHN A. FERNLEY. Forty-five per cent.

Mr. SIDNEY B. PAINE. Forty-five per cent. overload on the first generator. He then ran such of his departments as he could overtime. This shutdown of two days and a half was a shutdown of ten pairs of mules, and they shut down only because the mule spinners would not work overtime. It was not the fault of the electric drive, therefore, that he lost any production at all.

Just one more point. I did want to speak about the effect of temperature on motors, but it is too late. I do want to speak, however, about this question Mr. AYER has asked about whether it is more economical to use larger or smaller motors. That brings up the whole question of how far it is prudent or economical to sub-divide the drive in a mill. When motors were first brought out they were so comparatively expensive that the individual drive, as it was called, was not considered except in a few cases. Today, on account of the reduction in the price of motors — they are about half what they were a few years ago — the time is coming nearer when we can, as far as first cost goes, afford to drive our machinery individually. But there are other considerations that come in. If you take a weave shop which is on heavy work, where the filling runs out quite frequently on your bobbins, and therefore where the looms are stopped frequently, the sub-divided drive is advantageous. If you have a very valuable fabric, like the silk in Mr. OTT'S mill that has been referred to, where it would be very expensive to have any oil dropped from the shafting overhead or where the lint might be carried by the belt into that fabric, there is no doubt at all but what the individual drive is preferable. It is no exaggeration to say that there are thousands of silk looms today that are running each by its own individual motor. How far that would be carried in the preparatory machinery is a point that is yet to be determined. On the spinning frames there is no doubt that it is advantageous under certain conditions. I am equipping a mill today where we can drive all the spinning frames with individual motors, and under the conditions in that mill I have advocated it. In other mills I have advocated the group system. We must study each mill by itself and study the conditions, and not let our enthusiasm in favor of the individual drive run away with our judgment.

Referring to the last paragraph in Mr. FERNLEY'S paper, I would say that I have seen the same arrangement of two driving belts to the same shaft in quite a number of mechanically driven mills, and I consider It an unsatisfactory arrangement. I have pro-

tested against it wherever I have seen it going into the electrically driven mills, but in some cases my protest has not been heeded, although the electric drive has been blamed for the arrangement. But we did make a test the result of which it may be interesting to know, on this mill of Mr. FERNLEY'S. The man making the test was instructed to take off two belts on one end and make the test. I sent the message through a third party, and the man making the test got the message simply, "Take off two belts." Therefore he took off the two belts that were most convenient for him, the two outside belts; consequently he got this twisting effect on the motor, because he had one belt pulling one way and the other the opposite way. But even then the results on the friction load were that the four belts took 8.75 horse power and the two belts 7.25 horse power. We tested on the friction load because two belts were not capable of carrying the full load for which four belts were required.

The PRESIDENT. In justice to Mr. HATHAWAY, who is to read the last paper, I think the discussion should be closed with a few remarks from Mr. MERRILL. After he has spoken we will consider the discussion closed, in order to proceed with the next paper.

Mr. MELDON H. MERRILL. I notice that Mr. FERNLEY in his paper refers to a paper which I read before this Association at the spring meeting in 1905, in which I stated that "in some cases, all the motors on one floor are arranged to be controlled from the same station, thus allowing one operator to start quickly the entire department." Mr. FERNLEY does not seem to think this is a good mechanical arrangement, yet he says in the next paragraph: "The employment of so many different people in the starting of the motors involves danger," I would like to know what his objection is.

Mr. JOHN A. FERNLEY. I have no objection if it can be done. I do not see how the resistance comes in.

Mr. MELDON H. MERRILL. That arises from the fact that you are using the internal resistance type of motor. In my paper I was speaking of the squirrel-cage type of motor. There are several mills using this type of motor where one starting device is installed for each floor, and in some instances one starting device for each motor. In the latter case these starters are located at one central point, so that the operator can start all the motors without the necessity of going to each motor, thereby saving some time, which in some cases proves quite an advantage. Mr. AYER asked the question whether or not there was a "fool-proof" motor, having reference, I take it, to the starting conditions. I understood Mr. PAINE to say he thought possibly there was such a motor, but it was not practicable to use. Possibly I misunderstood Mr. PAINE, or, if I did not misunderstand him, he did not correctly state it. We have a number of mills in operation using the squirrel-cage type of motor, and in medium and small sizes there is no objection to this type. If the motors installed are comparatively large, say from one hundred to two hundred horse power, it is sometimes necessary to use the internal resistance type motors, but, if so, they can be constructed as we build them, with the starting device outside of the motor.

By using this type of construction we are all able to make this device of more liberal dimensions, and it therefore becomes practically indestructable and is not subject to burnouts and annoying results which obtain where the device is placed inside of the motor, where on the account of the small space available, the parts have to be rather small for the amount of current to be used.

There are many advantages in using the squirrel cage type of motor where the conditions are such as to allow its use.

The construction of this type of motor is much simpler than the resistance type and it is a very rugged form of motor better adapted to withstand severe overloads and abuse.

This type of motor can be built with a larger air gap than the resistance type. Mr. FERNLEY speaks of the necessity of blow-

ing out the dirt and dust which accumulates in the motor and the small wear on the bearings before they have to be adjusted. In the squirrel cage type of motor the air gap can be made practically twice that of the resistance type, assuming the same power factor and efficiency, or if the air gap is made the same as in the resistance type, the squirrel cage motor will have a somewhat higher efficiency and better power factor which are, of course, points in its favor.

* Objections have sometimes been raised against the squirrel cage type of motor on account of the large starting current required, that is, the current drawn from the line for a few seconds only while the motor is coming up to speed. With a starting device such as is furnished with this type of motor the starting current is from two to three times full load current when the starting torque is equivalent to full load torque. With the resistance type of motor under the same conditions the starting current is between one and one-half times full load current. Where the capacity of the motor is small in comparision with the generator this feature is not objectionable, where, however, the motor is approximately the same size as the generator or is located at the end of a long feeder and the generotor is operating at practically full load at the time the motor is starting, the condition is sometimes objectionable and in such cases, of course, it is better to use the resistance type of motor. On the other hand where the momentary starting current is not objectionable as in the case where the individual motor capacity is small in comparison with the generator, the squirrel cage type of motor has the advantage over the resistance type, as with the same air gap the efficiency and power factor is higher than in the resistance type. In textile mills the motors are started at most two or three times a day and the starting current is of only a few seconds duration at each time the motor is started, whereas the efficiency and power factor is of greater importance owing to the fact that the motors are in constant operation and anything

* Added to the stenographer's report.

gained in efficiency will consequently reduce the amount of power taken from the generator and consequently the cost of the same.

Mr. JOHN A. FERNLEY. I might say, Mr. President, that of course the question of the squirrel cage type of motors and resistance motors is too much to consider at this time. I think if that thing can be brought out more fully hereafter we can go into it to better advantage.

The PRESIDENT. We will now proceed with the reading of the paper on The Drawing-In of Warps by Machinery," by Mr. EDGAR F. HATHAWAY of Boston.

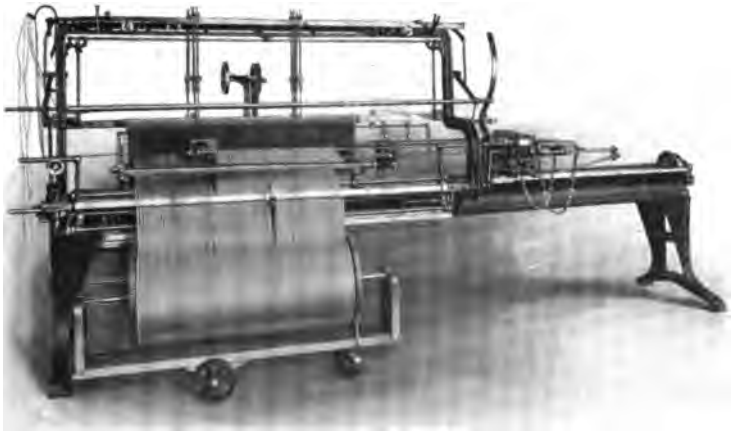
THE DRAWING-IN OF WARPS BY MACHINERY.

EDGAR F. HATHAWAY, Boston, Mass.

I wish to say a few words regarding a certain department in the cotton mill, which, while considered from a standpoint of simple cost is probably one of the smallest, but when you take into account its trouble causing qualities I believe you will all agree with me that it is the star department.

I am speaking now of the web drawing or drawing-in. The help in this department are of the higher class of mill operatives. They earn fairly good wages and are consequently independent and as of late years, this class of help seem to be coming more and more scarce they can afford to be more independent.

On the class of work they do we have heretofore depended for the smooth running of our looms and on the amount of work they do, has depended the running of our looms at all.



And now as I stated before, although the drawing-in of warps in itself has to bear but a small portion of the cost of manufacture of cotton goods, nevertheless, it being an essential preliminary to successful operation of the weave room, it forms an important factor in the process of economical production. It being in most mills the last and only operation which is now done by hand, has caused it to be a very attractive field for inventors all over the world to exhibit their powers in producing a machine for automatically handling this work by machinery. Attempts were made in this line many years ago, the first being taken up in foreign countries, after which many Americans of ingenious mind proceeded to invest their money and tangle their brains in an effort to produce a machine to successfully handle this work. The chief obstacle encountered (as far as my investigation goes) has been the accurate handling of the harness eyes. As you of course know a new harness as it leaves the harness maker is substantially perfect, having a perfect lease, each heddle alternating consecutively with its neighbor on sides of the top shaft. When this harness is new and in perfect condition it has been no great effort to produce a lease picking mechanism which would separate the harness eyes with a fair degree of accuracy, which fact has deceived many inventors (working invariably on a new set of harness) into thinking that they had solved the problem, even then, however absolute accuracy seemed impossible to obtain and after the harness has been several times run through a loom, subjected to the carelessness of the average weaver, the harness cleaner and repair man, it is indeed a sad object upon which to attempt to put a mechanical working lease picker and expect to obtain anywhere near the result that must necessarily be obtained in a successful warp drawing-in machine.

Until such a time as Mr. M. F. FIELD, who is now associated with the American Warp Drawing Machine Company conceived the idea of putting some kind of an appropriate spacing device upon the heddles, I can find no record of a warp drawing-in machine having come anywhere near making a successful demonstration in actual mill practice.

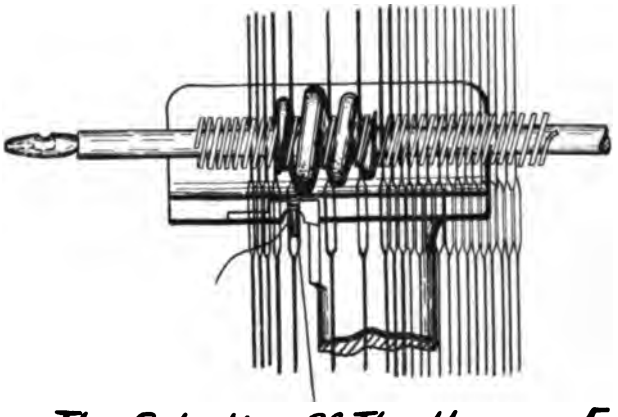
The American Warp Drawing Machine Company of Boston, Mass., taking the inventions of Mr. FIELD and putting them through a course of years of careful refinement, have at last produced a machine which is daily drawing-in warps through both the harness and reed at one operation, drawing successfully any pattern which may be desired up to six shade work, drawing any number of ends to a dent in the reed, or skipping eyes in order to allow for drawing a lower sley in the harness than same was intended for, thus making a great economy in the harness equipment necessary to carry where the work is liable to be varied. This machine uses standard harness and reed of any make and all the requirement that is necessary is to have the harness eyes in thoroughly good alignment and the only extra operation called for is to put on the heddles a so-called harness spacer, which, in this case, consists of a specially wound fine coiled spring which is applied to the harness in a simple manner.

Some of the advantages of this machine over hand work are as follows:

This machine is capable of replacing about four average hand operators as it will handle from thirty-five thousand to seventy-five thousand ends per ten hour day. It occupies only about the space ordinarily taken up by two hand frames. It can be operated as successfully by artificial as by day light. It gives much straighter warps than can possibly be obtained by hand-work, thus making a great economy in the weave room. It handles any style of one beam fancies and any number of harnesses (up to six) with the same accuracy, speed and economy as it handles prints.

It is now working daily on sleys as high as 160s and as low as 42s and on yarns from 12s to 90s. The operators are much quicker taught than those by hand, as they become proficient in a few weeks. The large number of ends it handles makes it show considerable economy, as the price paid for machine operators only ranges from about six to nine dollars per week when paid day work, and when on piece work the price is usually set at about one third the hand price, or from 3⅓ to 3½ cents per

thousand ends, while against this the only extra cost is the spacing of the harnesses which only amounts to about ten cents per thousand heddles, and is only done once for the life of the harness.



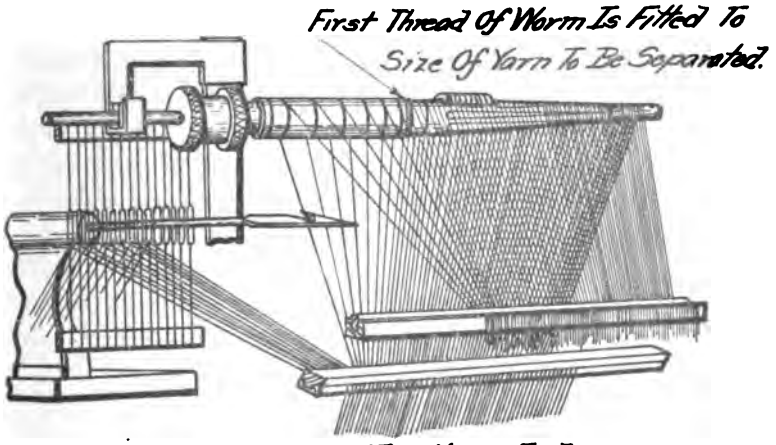
The Selecting Of The Harness Eye.

In the operation of the machine a worm or screw, something in the shape of a cork-screw, worms itself through the harness spring or spacer, taking a heddle with it at each turn, thus giving absolute control of each separate heddle. These spaces are placed on the harness when it is new and remain upon same until it is entirely worn out and discarded without any further attention. It in no way interferes with the action of the harness in the loom or with its durability, neither does it interfere with the same harness being drawn in by hand should the occasion arise, so that in only partially equiping a mill for drawing-in by machine it is not necessary to encumber it with a large amount of special equipment which can only be used on machine, but as I said before the standard equipment when once prepared for machine can be used by hand without any inconvenience whatever.

The reed, no matter of what sley, is carefully handled and the proper dent automatically presented for the passage of the

needle by a little device termed the reed-opener. This also operates on the principal of a worm or screw and consisting as it does of a single turn of a screw thread, which, resting in the dents of the reeds and worming itself through from dent to dent, as the pattern calls and never being removed therefrom during its passage from one end to the other, gives absolute accuracy, in fact the records of machines in actual practice show millions of ends drawn without a single error in the reed.

Many efforts have also been made to produce a successful automatic warp separator and probably no one in the world has given this element of the work the amount of attention given it by the company building this machine. All sorts of separators have been produced and experimented with and hundreds of inventors have submitted their ideas for trial without success. Most of these depend upon some sort of a fine hook or barb intended to deflect one thread at a time from the edge of a series of threads held in a perfect sheet, but owing to the many obstacles encountered in the nature of variations in the yarn, uneven slashing, knots, etc., coupled with the demand for straight drawing and absolute accuracy, full automatic separa-



The Separating Of The Warp Ends.

tors have thus far only reached the inside of the experimental room door in their struggle for practical usefulness.

The warp separator used on this machine is semi-automatic in the performance of its duties but is constantly under the eye of the operator in its action. This warp feed also involves the mechanical "worm" principle in combination with simple operating means giving the slope and tension to the whole body of warp threads and each component thread.

The operation of the feed as noted is semi-automatic and under such complete control that at the usual speed of 220 to 250 picks per minute an operator is enabled to do perfect work.

No additional or further preparation of the warp is required preliminary to the actual drawing-in work, it being upon the whole more simple to prepare than for hand work.

On low sleys the action of this separator is almost automatic and many warps are run through without even stopping the machine, but when the sley runs up to a very high count, or if the slashing is poor or the yarn rotton it sometimes necessitates a dozen or more stops in drawing a single warp, but these stops being very brief detract very little from the time of drawing the warp.

In the matter of obtaining any kind of a draw which may be desired each element of the machine is controlled somewhat similar to a Dobby head on a loom, inasmuch as a chain pattern containing tapped holes for pegs is run on the head and all that is necessary to do to obtain any kind of a draw is to use the same number of bars in the chain as there are threads or ends in the repeat of your pattern and insert a peg wherever a thread is wanted in any one of the harnesses, or where a change of dent occurs in the reed, using a peg in every hole for the warp control and simply leaving out a peg when no warp thread is wanted.

In arranging to put this machine out for every day use in the mills the company manufacturing same was quick to realize that owing to the large amount of experimental work that has pre-

viously been done in this line and the poor success that has heretofore followed the same, the mill people were skeptical as to the results which might be obtained from a mechanical warp drawing contrivance. They consequently realized that it would be an impossibility to place this machine on the market and sell it outright at a price which it would be necessary to obtain for a machine as well built as it was necessary to have this one, so taking the foregoing into consideration the decision was made that the machine should be leased, or in other words, put out under annual rental, so that in the end, the mill would have no investment to stare them in the face and at the end of any long term would still have for their use a machine which was every bit as good as the day it was placed in their mill, besides having the benefit of any improvements which are bound to come up through any enterprising firm which is trying to put upon the market an article which they wish to be the best that can be made.

This system, while it is common practice with the builders of other machines, was a new departure in the line of handling cotton mill machinery and at first met with some strong opposition on the part of the mill man, but after same was thoroughly installed and many machines successfully running and the mill people had an opportunity to see the constant care and attention that was given machines placed in their mill I am lead to feel that the system has met with a thorough approval of both sides, or much so that now the question of purchase is no longer ever saised, as under this system the bugbear of depreciation is not for ever staring at the mill from their books, but in place they are given a machine which is constantly kept up to the highest standard of improvement.

Those who saw this machine when first put out in a form largely experimental would hardly recognize it in its present improved and simplified form and a visit to some of the mills using it cannot help but be of interest to those who wish to improve the quality and reduce the cost of their drawing-in.

This company have also perfected a tying-in machine which

though it has not yet been placed in active work in the mills, will eventually supplement the drawing-in machine by handling work that cannot conveniently be drawn-in mechanically, but comparative tests have shown that when we take into consideration the cleaning and repairing of the harness, together with the fact that warps for drawing-in machines are taken direct from slasher without any special preparation, then the drawing-in machine is by far the most economical and convenient on all work within its range.

Twisting-in seems to have almost disappeared from the plain goods mill and drawing-in by hand is fast becoming a thing of the past and I predict that in another two years the drawing-in of plain warps by hand will be considered about as great a departure from economical mill practice as would be the adoption of the hand spinning wheel or the hand loom.

Mr. GEORGE OTIS DRAPER. Mr. President, I notice on page 289 of Mr. HATHAWAY'S paper the statement:

"Full automatic separators have thus far only reached the inside of the experiment room door in their struggle for practical usefulness."

I had thought I had seen automatic separators working on drawing-in machines very successfully. I merely ask Mr. HATHAWAY to explain.

Mr. EDGAR F. HATHAWAY. I presume you refer to the separators used on the Colman tying-in machine — is this what you would consider fully automatic?

Mr. GEORGE OTIS DRAPER. That is the way I considered it from my own impression.

The PRESIDENT. What rent is charged for this machine?

Mr. EDGAR F. HATHAWAY. The company make two types of machine. They make a simple machine that takes two-shade work only, its advantage being that it is susceptible of slightly higher speed. We get about 250 revolutions per minute out of it, but, as I say, it will take only two-shade work. For that machine we get a rental of $250 a year. Then we make another type of machine, or rather two other types, taking up four or six shades, and these machines will draw any lesser number of harness. That is, a six-shade machine will draw three, four, five or six. For this the annual rental is $300.

The PRESIDENT. Do you know what the rental figures per thousand ends on the product of the machine?

Mr. EDGAR F. HATHAWAY. The average daily output is in the neighborhood of 50,000 ends. We are drawing as low as 30,000 and as high as 75,000.

The PRESIDENT. So that it would be a fraction of one cent?

Mr. EDGAR F. HATHAWAY. Yes, a fraction of one cent per 1,000 for the running.

Mr. WILLIAM D. HARTSHORNE. In reference to this automatic arrangement, supposing that you had a fancy warp of various colors and only one or two ends occasionally following each other and a slashed warp, — can this be done without picking a lease on the warp?

Mr. EDGAR F. HATHAWAY. You mean, Mr. HARTSHORNE, and keep the colors properly separated?

Mr. WILLIAM D. HARTSHORNE. Distinct, yes, sir.

Mr. EDGAR F. HATHAWAY. The warp separator, as you will note here, is under the eye of the operator, and of course if a colored or striped warp and is accurately slashed. It will come up on our separator fairly accurate. Nevertheless, in handling striped work we very often have to correct it. Even if it is slashed perfectly one thread will get crossed over another.

Mr. WILLIAM D. HARTSHORNE. I understand. That was the point I was going to make.

Mr. EDGAR F. HATHAWAY. Then we use on the machine in intricate striped work, shaded work, etc., simply a bell indicator which strikes a bell when the last thread of the color has passed, showing the operator that the next thread should be of the changed color. In that way, while we cannot show the great economy in drawing-in — nevertheless, we can draw a warp that is absolutely perfect in these stripes — no matter how intricate; but on account of the stops, unless the slashing is very accurate indeed, it cuts down the product so that there is no very great direct financial benefit derived from it.

Mr. HOWARD D. COLMAN. Inasmuch as Mr. HATHAWAY has implied in regard to the question which Mr. DRAPER raised, that the machine made by the company which I represent does not do perfect work, I wish to say that our experience with it shows that at least it does better than hand work. I would claim as much in that direction as he, and I would like to ask in what respect he does not consider our warp separator to be a full automatic warp separator?

Mr. EDGAR F. HATHAWAY. In reply to Mr. COLMAN I will admit that probably the tying-in machine does do better than hand work, because any mechanical affair that is a fairly good working machine cannot help but be more accurate than the unaided judgment of a hand operator. In regard to the accuracy I am possibly — probably — not qualified to criticise, not having seen the machine for some time, and when I did see it

possibly you people were not quite through it. However, as I say, I am not in a position to criticise and I am not here to criticise anybody's else production but to speak of the advantage of drawing-in warps by machinery. In regard to the warp separator I was not aware that it was full automatic in its action, because it required starting and stopping by hand—not necessarily stopping, however, because, as I understand it, Mr. COLMAN, the machine stops automatically if it does not get a thread, but it does not stop automatically if it takes a double thread.

Mr. HOWARD D. COLMAN. That is perfectly true. However, the taking of double threads is so rare as to be a negligible quantity, and the stopping when it does not take a thread hardly averages once a warp. I think all machines that stop when they make an error are not thereby debarred from being called automatic. I think our warp separator is fully automatic in the common acceptation of the term.

Mr. JAMES O. SWEET. Just two questions I wish to ask. The first is whether it requires only one person to attend this machine. Of course you have more persons to bring the beams and take them away, have you not?

Mr. EDGAR F. HATHAWAY. Yes, the machine is operated entirely by one hand.

Mr. JAMES O. SWEET. I want this other thing settled. As I have heard it, it has been intimated that this machine is more destructive of harness than is the case with hand drawing.

Mr. EDGAR F. HATHAWAY. I am afraid you have 'been somewhere where experimental machines were put out.

Mr. JAMES O. SWEET. Yes, wherever I have been. You can set it right.

Mr. EDGAR F. HATHAWAY. That is not true. In fact, people who are using the machine every day will tell you that it is much

easier on the harness. I was told only last week by a man running a print mill which has seven of these machines and is drawing all its warps by machinery, that he had harness in the mill which was purchased four years ago, and that harnesses had never before lasted him three years. That is not due, probably, to the machine being any easier on the harness, but it is due to the fact that they must necessarily repair the harness properly. I do not mean to say that running the harness through the machine is any easier than running it by hand, but it is necessary to have the eyes in the harness, and they must therefore be careful, instead of, when an eye is missing, cutting it out.

There being no further discussion the meeting was declared adjourned to 8.15 P. M.

FOURTH SESSION.

THURSDAY EVENING, SEPTEMBER 13, 1906.

Meeting called to order at 8.15 P. M., President MACCOLL in the chair.

The SECRETARY. There is one matter that I wish to call to the attention of the members relative to the design of the members' badge I suppose that it has been assumed by everybody that it was merely chosen in recognition of SAMUEL DE CHAMPLAIN as the great discoverer of this the largest fresh water lake in the domain of the United States. But CHAMPLAIN has also a relation to the purpose of this organization, because in his record of the battle with the Indians at a bay a few miles south of this point on July 2, 1609, where he tells us he put four balls into his arquebus and fired at thirty paces and shot two chiefs and put a bullet through another and addition to that, he states that the Indians wore an arrow-proof armor, which was made of pieces of wood bound together with cotton yarn. This is, I believe, the first reference to cotton in connection with this country. [Applause.]

ELECTION OF MEMBERS.

The SECRETARY. Mr. President, the Board of Government submit with their approval, a list of thirty-one candidates for membership which have been placed, after scrutiny, upon a ballot which is submitted to the pleasure of the meeting.

The PRESIDENT. I will appoint Mr. JAMES G. GARLAND and Mr. H. C. ATWOOD as tellers. They will please distribute the ballots.

The tellers proceeded to the discharge of their duty, and the ballots having been distributed and collected, the polls were declared closed. The tellers subsequently reported that thirty-six ballots had been cast all for the following candidates, whom the President declared elected, viz: —

FOR ACTIVE MEMBERSHIP.

ORIN F. BENNETT, Supt. Naumkeag Steam Cotton Co., Salem, Mass.
By WILLIAM P. MCMULLAN.

OBADIAH BUTLER, Supt. New York Mills Co., P. O. Box 14, New York Mills, Oneida County, N. Y.
By LAVATER W. POWERS.

REUBEN A. COOKE, Treas. Queen City Cotton Co., Lake Side Ave., Burlington, Vt.
By GEORGE OTIS DRAPER.

WILLIAM E. ELSBERRY, Sec'y and Treas. Tallassee Falls Mfg. Co., Tallassee, Ala.
By E. W. THOMAS.

C. B. GORDON, Vice Prest. Dominion Textile Co., Ltd., 112 St. James St., Montreal, P. Q. Canada.
By A. B. MOLE.

JOHN W. KNOWLES, Treas. Page Mfg. Co., New Bedford, Mass.
By SAMUEL TAYLOR.

OLIVER N. LONG, of Long Bros. Co., 3d and Ontario Sts., Philadelphia, Penn.
By ROBERT BEATTY.

R. P. MCLOUGHLIN, Asst. Treas. and Asst. Mgr. La Tosca Yarn Mill, Utica, N. Y.
By D. W. GRAY.

WINTHROP PARKER, Supt. Queen City Cotton Co., 54 Bay View St., Burlington, Vt.
By C. H. FISH.

JOSEPH G. RAY, Treas. The Putman Mfg. Co., Woonsocket, R. I.
By GEORGE A. VAUGHAN.

WILLARD W. STEARNS, Supt. Nos. 1 & 3, Farr Alapaca Co., 224 Pine St., Holyoke, Mass.

By GEORGE A. AYER.

PAUL E. SUTRO, of E. Sutro & Son, Thomas & Clearfield Sts., Philadelphia, Penn.

By ROBERT BEATTY.

GEORGE M. TRABER, Mgr. The Perry Knitting Co., Perry, N. Y.
By ROBERT A. COPELAND.

FREDERICK A. UPHAM, Asst. Supt. Palmer Mill of the Otis Co., Three Rivers, Mass.

By FRANK J. DUTCHER.

WALTER WHIPPLE, Supt. Monadnock Mills, Claremont, N. H.
By FRANK P. VOGL.

E. WILKINSON, Jr., Member Firm E. Wilkinson & Son, Amber and Adams Sts., Philadelphia, Penn.
By ROBERT BEATTY.

EUGENE F. WILLEY, Supt. Bennett and Columbia Mills, New Bedford, Mass.

By R. A. GRAY.

KENNETH F. WOOD, Supt. Sayles Bleacheries, Saylesville, R. I.
By JAMES R. MACCOLL.

FOR ASSOCIATE MEMBERSHIP.

JAMES H. BRAND, Jr., Cotton Broker, 201 Board of Trade Building, Montreal, P. Q.
By LOUIS SIMPSON.

HERMON N. BURPEE, Gen. Sales Mgr. Barber-Colman Co., 77 Washington St., North, Boston, Mass.
By HOWARD D. COLMAN.

THOMAS J. CLEXTON, Mgr. A. KLIPSTEIN & Co., 285 Congress St., Boston, Mass.

By JOHN H. WHITTEN.

ARTHUR A. HASERICK, Member of Firm Stoddard, Haserick Richards & Co., 152 Congress St., Boston, Mass.
WILLIAM D. HARTSHORNE.

WILLIAM C. HAWES, Director Taber Mill, Pleasant St., New Bedford, Mass.
By C. P. BROOKS.

SAMUEL T. HUBBARD, Cotton Merchant, Hubbard Bros. & Co., 66 Beaver St., New York City.
By JAMES R. MACCOLL.

EDWIN H. MARBLE, Vice Prest. Curtis & Marble Machine Co., Cambridge St., Worcester, Mass.
By JAMES R. MACCOLL.

EDWIN T. MARBLE, Prest. and Treas. Curtis & Marble Machine Co., Cambridge St., Worcester, Mass.
By JAMES R. MACCOLL.

J. FRANKLIN MCFADDEN, Member Firm George H. McFadden & Bro., 121 Chestnut St., Philadelphia, Penn.
By JAMES R. MACCOLL.

ARTHUR N. SHELDON, of F. P. Sheldon & Co., Mill Engineers, 49 Westminster St., Providence, R. I.
By JAMES R. MACCOLL.

ABBOTT, P. SMITH, Director Soule, Butler and Kilburn Mills, Seventh St., New Bedford, Mass.
By C. P. BROOKS.

JAMES A. COOPER, Whitin Machine Works, Whitinsville, Mass.
By E. KENT SWIFT.

ROLAND GERRY, Asst. General Sales Agt. Jones & Laughlin Steel Co., Pittsburg, Pa.
By JAMES R. MACCOLL.

The PRESIDENT. Ladies and gentlemen, the subject of child labor is one of great practical interest to cotton manufacturers. We cannot operate our factories without child labor and every restrictive law tends to make it more difficult. Yet, on the other hand, we have a deep interest in everything that tends to develop

a higher American citizenship. Our Board of Government has thought it proper to have this subject of Child Labor in relation to Textile Mills presented to this convention, and we have been fortunate in securing for this purpose a gentleman who is an authority upon this question, Dr. TALCOTT WILLIAMS of Philadelphia. [Applause.]

Dr. TALCOTT WILLIAMS. Mr. President, ladies and gentlemen: You would not be present here on your own invitation to hear me and I would not be here upon your most welcome suggestion that I should address you if we were not both of us interested in the subject of child labor. Of its moral side you have heard many speakers. For myself, while my feelings are as strong and my convictions as deep on that subject as any man's could be, but I believe no stronger than those of every man in this room, for we are all agreed on moral questions — our only question is as to the application,— I lay that aside as not one of the subjects which I take up this evening. There is another side, the influence of child labor upon the next generation. Upon that everything has been said which can be said, and I do not propose to add to what you have already heard. There is the statisitcal side of child labor, its comparative side presenting child labor in different countries. That, too, has been discussed until every man and every woman in this room knows the general facts upon the subject. I propose instead, if you will allow me, to look at the question in none of these relations, but to look at it as part of the general progress of society.

CHILD LABOR AND THE TEXTILE FACTORY.

TALCOTT WILLIAMS, LL. D., Philadelphia, Pa.

We are near the centennial of the subject upon which I address this Association. It is now one hundred and two years since Sir ROBERT PEEL's Apprentice Act in 1704, began legislation upon child labor. Since then, there has been no decade in which some investigation did not attract universal attention, no five years in which some law was not passed somewhere on the subject. From the decree of the Emperor, JOSEPH II, in Austria in 1787, prohibiting the employment in factories, of children under nine, "unless there be necessity for it" which began public law on this issue, to the Act passed by the Georgia legislature this summer, there has been a continuous stream of legislation, one international conference ten years ago, and innumerable meetings, associations, pamphlets, books, speeches and addresses during over a century. To this heap this evening, I add this pebble, aware that I can say nothing new, but anxious if possible to place this subject in such relations to the wider social progress of which it is a part, that it will be seen that it can be discussed without bitterness or accrimination and that each of us may see his own social duty in a light which will lead him to desire to follow it.

During all this period of agitation and legislation there has probably been no day in all the hundred years in which some textile manufacturer, often the general body of men controlling this great industry, has not felt that the criticism and constant attention drawn to child labor in the textile factory was unfair and did a wrong to himself or his calling.

From the day of Sir ROBERT PEEL'S speech upon the cotton and woolen manufacturers in the textile district of England, to

the present hour, the textile manufacturer has found himself a mark for this sort of thing, not always an easy mark, often a protesting mark, but still a mark.

None of us enjoy the pillory as a place of residence. The textile manufacturer is perfectly aware when he sees himself singled out, that he is not a sinner above all those upon whom the pillar of industrial law has fallen in the manufacturing Jerusalem. He knows that he is in business as other men are, not exclusively for his health. When he looks about him he sees that he is bearing his full, fair share of the burdens of society of taxation and those personal gifts which each of us in our American community, where every soul is touched with the finer sense of mutual personal obligation, bears and discharges in larger or lesser measure as temperament and opportunity inspire and permit.

The textile manufacturer knows that the worst evils of labor are not in his factories but linger in those relics of the household industry of what we are often assured among many economic fallacies was a happier age than this. He knows that the great shop of the city, metal and mineral trades, cigar making and a score of lesser avocations and occupations in which miserable beings drudge along, doing some work, long since out of date but which they are too weak or too indolent to leave or which some captain of industry has not yet organized on that great scale which is an achievement so benevolent, so beneficent, that it constitutes one of the greater victories of peace no less renowned than war, are far worse in their conditions than the textile factory.

If he is old enough, as some men before me are, to know what it was to work without the machinery and conditions of the modern mill, he knows how greatly he has improved the conditions in which all under his spreading roof labor. If he is reminiscent and philosophic, he looks about him and sees that in a hundred years he has created a domestic problem in every household by making life in the mill so much more attractive than life in domestic service — where he probably notes that legisla-

lation has never sought to limit hours, to exclude the child or to regulate cubic air and temperature, although when he began his work service in hall and house ranked higher socially and was more desired than work in the mill, in England and measureably here after a century the reverse has come and the factory draws to it so much more of the paid labor of women than our domestic institutions appear likely to be recast by the difficulty of securing maid servants.

The mill owner in general, and the textile mill owner in particular, however he may approve and support the long chain of legislation which in a hundred years has shortened the hours of the factory from one-third to one-half, has rolled back the age of labor from six to eight, to fourteen to sixteen, and has ameliorated and improved dwellings and clothing, yet still feels that during this process and progress, he has been accused of offenses which he never committed and held responsible for conditions which he never created. Like other men, he has bought his labor in the cheapest market. He has accepted the decision of children and their guardians as to whether they were fit to work or not and he is aware in his deepest consciousness and his conscience that on the whole, the work of the textile manufacturer has done as much to lift the general level of the labor and advance its environment as the work of any other employer whatever. These opposing views of those who from Sir ROBERT PEEL and Lord ASHLEY down to the various speakers on this subject, who are today still very much with us and of the textile manufacturer, whose irritation and protest both have their justice, I propose this evening to ask you to see as part of the common and inevitable action of society, reaching a particular end as ends are reached in all fields by converging forces. When a social process has lasted a hundred years, has worked itself out in a score of countries, is the subject of an entire library of investigation, observation and deduction. It ought to be possible and I believe it is possible to show that these changes which often seem so fortuitous, the accident of agitation or the lobby or the result of wisdom or of folly, instead follow a steady continuous,

unvarying law, whose course and action we can now not only see in the past but predict in the future. The only value of such prediction in this, as in all things, is that it shall guide us to our social duty. The only reason that the Ten Commandments have "not" in them, is even with reference to those about whom we are almost sure, like the sixth or seventh, that there had been before they were accepted, as a guide the fruit of various experiences by human beings, in their opposite. People had tried the other thing as they still sometimes do and had discovered that there were certain acts which it was wise to take with a not.

Nearly every utterance on child labor, particularly the child labor of the factory, begins with the tacit assumption that there was a halcyon, and considering the character of children, a vociferous period when all children were at play. The plea for factory legislation all the way through has generally assumed that until the factory appeared, the child was free and we are asked to assume that at some period before the "factory system" was introduced everybody's children had time to go to school, to play, to live healthy lives and to be free from the thralldom of work. The factory, we are constantly told, has enslaved the child. As a matter of fact, it would be more just and accurate to say that the factory has, as a part of the industrial system with which we are familiar, emancipated the child. The only chance the child has ever had for schooling, abundant play, and the freedom which was through all the ages the denied and delayed birthright of childhood, has come from the industrial system of today.

If I were to take you to any land at this hour, where manufacturers are still at the handicraft age and period which preceded the factory, and a certain school in economics is perpetually hymning, you will find all the children at work. In an industrial system unaided by steam, unorganized by the factory and unprovided with machinery, it is impossible to get the industrial work of the community done without employing every atom of available labor. When you go to the den of the weaver in any Asiatic town from China to Turkey and enter the damp,

dark place, in which, in a hot climate, he handles his primitive loom, you find in all of them children of four or five years and upwards, busily at work. The man in every industry expects under primitive conditions where all the textiles are spun and woven by him, where every iron tool is patiently shaped on the anvil, where every earthenware utensil is turned on the wheel to use all the child labor he can produce.

The child in all the industries of this period is an industrial asset of the first magnitude. The apprentice law of England from an immemorial period permitted a child to be indentured at four years of age. In all the East which still preserves in its ignorance, its squalor, and the iron furnace of endless work, the happy traditions of that age in which everybody was industrially equal because nobody had enough to be anything else, the children are at work all the time and the hours of work start as they did with our great grandfathers, at sunrise and continue while there is light. Even on the farm today, except as machinery has altered conditions, the labor of the child is needed as soon as the child has intelligence enough to obey an order or drive the cows up from pasture.

The reason there never was any common school until after the factory had organized society, was because it is practically impossible under the rude conditions of hand labor to spare the child long enough from the day's job, to learn more than a few rudiments and in some 1,000,000,000 or 1,200,000,000 of our fellow beings the thralldom of the child is so complete that not one in ten or twenty, and then only the children of the advantaged, ever learn to read at all. It is not long since the summer and winter schools of New England were arranged as some of those before me well remember, so that the larger children were taught in winter when they could be spared from farm work and the younger children in the summer when their labor was less needed.

You have only to leave the railroad in the south and travel as I have for weeks together, with a mule and a buckboard, through the mountain region which extends from south-western Pennsyl-

vania to northeastern Alabama, or to go in a fishing boat along the broad but shallow waters of our Atlantic coast, from Albemarle Sound south, stopping in both cases in the homes of the people, sharing their life and food, and watching their work, to find yourself in communities where the labor of the child is indispensably necessary in order to fight hunger, furnish clothing and provide for those months in the year when food and fuel are needed. The child in such homes is at work as soon as he can toddle.

This is the history of society from the cave dwellers up. We, after a century of the factory system, look upon the child as offering to us the happy privilege of laboring for helpless; but you have only to be old enough to have talked even with men who were born in the eighteenth century and lived in the nineteenth, or to enjoy the advantage of a settled family tradition which has passed along in yellowing letters in worn diaries and by word of mouth, the life of the seventeenth and eighteenth centuries to know that then men bought their freedom of their parents and were expected as a matter of course to labor for the family home until they were twenty-one.

Who of us ever heard of a boy buying his freedom today? Instead, if we have to find a fault with the boy of today, it is that his declaration of independence begins as soon as he can walk, and that he takes his freedom at the earliest possible moment without hesitation or protest. Child and youth were harnessed as we all know, if we stop to think about it, to the industrial car through all the years and centuries of hand industry and there never was a time as is assumed when the child enjoyed freedom from work up to certain years, until it was assured by the laws of the past century which we are now reviewing.

This difference exists between child industry then and now that the labor of the factory being continuous, ordered, governed by hours, carried on with machinery and not ameliorated by the personal contact of home life and the small shop gives less time for individual volition and personal development. As on the farm, hours may be long, work continuous, and the child may

be kept constantly occupied, but the variety of employment, the certainty that there is constant demand for fresh initiative, the fact that the child is working alone, or with a few companions, makes the work better for the child, gives education unconsciously, and stimulates those qualities which often constitute the result of a more valuable education secured in work of this kind than can be obtained by the common schooled boy or girl. In fact, if I were to turn aside to another problem, I would be justified in saying that the great difficulty of today in the education of children under sixteen is to provide artificially in the school by manual training and other experiences, that variety of employment and that development of the molor and moral centres which takes place as a matter of course on the farm and when industries were confined to the small shop and the household of the weaver, the mechanic or artisan. But for all these balancing factors, it is still true that the child under the conditions of industry which preceded the factory had to work, was kept at work, and legend, folklore, and popular impression reflected in the literature of the day show the lot of the apprentices to have been hard and cruel. We see the reflection of these conditions in our immigrants who come to this country believing that it is the duty of children to begin at the earliest possible moment to aid the fâmily exchequer by their work. This exists, I call you all to witness, in precise proportion as the immigrant comes from primitive countries. If the immigrant comes from a region where factories have been organized for two or three generations, he or she does not look for comfort and aid from the labor of the child, at as early an age as the immigrant from Eastern Europe, Russia, or Hungary, who comes from a region where industry is still at the handicraft or household stage.

The preconception that the child ought to work and that the parent had a right to the labor of an adult child, a girl until she was eighteen, and a boy until he was twenty-one, you will find universal even in communities as far advanced as New England in the middle of the eighteenth century. As for the rest of

Europe, the child was kept at work as a matter of course and a large part of the cruel corporal punishment which plays so depressing a share in the annals of childhood before the organization of industry freed the child is really due to the desire and necessity of keeping the child at work, when the child should have been at play.

With this preconception which exists in every community emerging from the era of mere handicraft and is entering upon the factory stage, it is a matter of course that the child should be set to work. You can see this feeling in full operation in the families of the Southern poor whites. They have the purest American blood of the land. Their valour; their readiness to die for a cause and their willingness to bear privation were attested on every battle field of the civil war for four years. Their unnumbered and unknown graves ridge all the South. But in spite of qualities so fine and natures so noble that I have felt that some of the best men and women I have ever met were those in some mountain hut who could barely read and write, if they could do that, or in some fisherman's cabin on our Southern sounds, these people still feel that the labor of the child is the due of the parent. They are today just where the parent of old England and new England was a hundred and thirty years ago, when ARKWRIGHT in 1769 took out his first patent for spinning cotton and yarn, COMPTON introduced the spinning loom in 1779 and CARTWRIGHT the power loom in 1737. These created the factory system and when the doors of the factory were opened the child sought the factory because the weaver of the day had always employed the labor of children at an age as early as the child work. No one realized or could realize how great the difference was between the monotonous labor of the factory and labor found in the weaver's loom in his own cottage. As a matter of fact it was very soon discovered that the community could spare some of the labor, and where before the child had begun at four or five, for the overwhelming majority of children earlier even, then legislation on the subject, the beginning of labor instead of being at this atrociously early age, began at six or eight. The presence of the child at work is now, therefore,

as it is constantly represented to be the more or less deliberate desire of the textile manufacturer to get the cheapest wages or his willingness to play the part of a child slavedom. It is instead the adoption and the survival under the factory system of exactly those conditions which were necessary and inevitable when human labor had not been saved by steam and machinery on a scale which has enabled law to emancipate labor of children for fourteen states, under fourteen and from night labor in twelve states more, while in nearly twice this number of states, the child is emancipated up to ten or twelve.

This process has been in progress as I have already said so long that we can now both describe and predict its successive stages. When the factory is first opened the families, as a matter of course, whose children have always worked, will see no reason why they should not continue to work in the factory. Children of an age so young that it makes the heart bleed to see them toiling will stand by night and by day at the machine. Meanwhile four great influences are at work.

1st: The factory by making the labor of a community more efficient, turns out by the labor of one adult, as this audience knows, better than any other in the land, more than the collective labor of many adults and children in the past.

2nd: As machinery is improved and grows more intricate and perilous the labor of immature children becomes uneconomic and wasteful. It often continues as is constantly forgotton under these conditions not from the desire of the manufacturer, but under the pressure of the parent.

3rd: The great increase in wealth which comes with the organization of industry widens the area of taxation and permits for the first time a public revenue sufficient for the education of the child.

4th: Last and most important of all for the factory and all things else exist not for material but for moral ends, and their success is to be measured not by the multiplication of dollars but by the quickening of the moral sense in the community which in the case of the English law, had lived for centuries

callous to the unspeakable cruelty of an apprentice system, akin to slavery which would begin at four years of age, the community awakens to the duty of educating the child, regulating enforcing, and defining by law, the emancipation whose material foundation was laid by the organizer of industry and whose moral impulse comes from the philanthropist and the agitator against child labor, each often embittered and hostile, but both in the wider organization of society, common yoke-fellows in drawing the car of progress.

These changes have followed in regular order wherever the factory system exists, but in decreasing time. It took seventy years in England for the cycle to be run from a period when nearly half the labor in textile manufacturing was of children under fourteen and sixteen years of age, until the limit was drawn at ten and a half time introduced between ten and twelve. In Massachusetts the cycle was completed in about fifty years. It has run through a similar course in most northern manufacturing states, in the southern states it promises to take about twenty-five years. This is no accident. Social reform and the social conscience act with a constantly increasing speed. In all these fields the same course has followed. The limit is first drawn at ten without reference to schooling. It is raised to eleven or twelve, with the requirement of school attendance. When the limit of labor is raised to fourteen invariably compulsory education exists and the community can feel certain that if it shuts the child out of the factory, he will be required to attend school.

All these changes follow a gradual and constant social development in which the advance of the years at which children are permitted to labor is accompanied by corresponding advance in their education. It is impracticable on one side to carry the exclusion of children from the factory much beyond ten or twelve years until the schools are ready and exclusion to fourteen years for day work and to sixteen for night work is inevitable when a real compulsory education backed by the truant officer begins.

The demand for the restriction of child labor is too often treated by the factory owner and manager as the demand of the philanthropist, ignorant of the real conditions. The philanthropist is on his side too often blind to the fact that the sins which he attacks are but part of the transition stage in which society is passing. The danger on both sides is that it will not be realized that this is a transition stage, the factory ought at the earliest possible moment to relieve itself of this labor and that the demand for legislation ought to take effect and account of the social condition of the region and advance the age at which children are permitted to work, with the advance of education in that region.

The risk in the south, to speak plainly, is that this will be delayed too long and that the white race whose children are working and not going to school will be placed at a disadvantage with the colored race, whose children are not working in factories and are going to school.

But on both sides it must be clearly understood that the movement for the abolition of child labor is simply part of the general progress of society. It can be delayed by the opposition of the factory for a season but not long. It can be quickened by agitation, but the speed with which this restriction comes cannot be much increased. No palliative, no provision by the factory or betterment school can meet a demand like this which rests on a fundamental movement of society which must be recognized by law. For all concerned, for the factories which in every country in its early stages has employed children, for those who urge the necessity of restricting the age at which this employment is possible and for the legislator called on to act, it is necessary to look upon the duty of each, not as part of a struggle over cheap labor or dear, over the freedom of factory employment or its restriction, but as a part of that great movement which the unconscious and conscious forces of society carry on together.

I am certain that for every man here, duty and obligation in this great issue present themselves in a different light when he realizes that his own personal responsibility is not to be meas-

ured by the balance sheet of the factory, the demands of ignorant parents for employment or the demand on the other side for extreme legislation, but he has bound himself as a factory owner, as employer, and above all, as citizen, to remember that the regulation of this issue follows a social law as regular as inevitable and as inexorable, as those of nature and that it is unwise to resist as it would have been in an earlier age to anticipate the necessity of restricting the labor of children, from stage to stage until we reach what is eventually coming, a state in which every child will be educated until it is sixteen or eighteen years old and in which the family income will be large enough in classes least well paid, to permit this education.

The value of all wealth, let us not forget, is measured not by material resources but by the training and education of the community. If your labor is at a jungle level, in the end all things else will be measured by the cost and profit of the jungle.

No factory can afford in the long run to be surrounded by labor which only makes the coarser goods possible of production. Every community must be prepared by restricting the labor of its children and increasing the intelligence of the operator to relieve itself from those coarser goods in which competition is general and passes to those finer fabrics in which competition plays a constantly increasing share as a more specialized skill is required. This change has come in France, is coming in England and will come elsewhere.

The day has passed when the line can be drawn between the work of the business man and the work of the statesman. The factory owner and manager requires in these days of rapid and widespread competition the scope and vision of the statesman and I have spoken in vain if I have not for an instant lifted a problem we are too apt to confuse by wrangles over the precise year at which child labor shall be restricted, into one of those greater questions which call in every man engaged for knowledge in the past of the conditions of its progress and their application to the present and the future in the regulation of child labor by providing at the earliest possible moment education and restriction, hand in hand.

Mr. GEORGE OTIS DRAPER. Mr. President, I do not rise to take issue with Dr. WILLIAMS on any of the phases of this subject which he has introduced, but I think there are phases which no writers that I have read have ventured to touch on, — some very important phases. Our civilization is advancing, and with its advance introduces new ranges of desires and makes people ambitious. Our working people of today under our present laws in some states, have to rear families of children, support them, feed them, clothe them properly to mingle with other children in the schools, and derive no financial assistance from them until they reach an age rather mature. I think the result of this is that our northern families which have advanced, as we may say, in civilization and had the advantage, if it be an advantage, of some of these laws, are not having families. I think it is a question whether it be advance to reach the stage of having less children rather than having children some of whom have to work several hours a day. I am not so sure myself that the present trend to give children additional schooling instead of letting them have some occupation is entirely for their best interests. Under our present school methods a child has to attend school six hours or more a day and very likely take books home for extra study. I am not at all sure that it is best for the pupils' development that they should have so many hours of mental occupation of that nature during a day. I am not at all sure that occupation in a factory for part of the day, at least, would not be better for them in many respects. I have an idea of my own that possibly some day a compromise will be introduced whereby children can work on half time in the factories and attend school a few hours a day, part of them working in the morning and attending school for a few hours in the afternoon, and the others shift about. It seems to me that we have not arrived at a stage in civilization where we can produce enough products so that the average person can have enough of the advantages of civilization without getting some revenue from children of the ages at least of twelve to fourteen and sixteen. I merely introduce this idea to arouse discussion. I thought this over while hearing Dr. WILLIAMS and this is what it has brought forth.

Mr. GEORGE A. AYER. Not having had the pleasure of hearing all of Dr. WILLIAMS' address, I draw some ideas by inference from Mr. DRAPER'S words. I wish to say that the average New England mill superintendent, is fully a believer that every man-child and every woman-child should receive all the advantages of education that are possible under the laws of the state. And I fully believe that very few ever intentionally violate the laws of the state of Massachusetts, which I believe is a leader in its provision by law for the education of children.

Mr. JAMES O. SWEET. I do not rise to discuss the question of child labor. As Dr. WILLIAMS has said, there has been discussion for a long time, and in some magazines very uncomplimentary to those who employ child labor. I wish simply to say that this discourse given to us by Dr. WILLIAMS of Philadelphia is one of the best, most intelligent and comprehensive discussions that I have heard on the subject, and whatever the future may bring forth he is deserving of the best thanks of this audience.

The PRESIDENT. If there is no further discussion Dr. WILLIAMS will now reply in a few words to what has been said.

Dr. TALCOTT WILLIAMS. I will venture to take five minutes of your time in a brief reference to what my friend Mr. DRAPER has said. I feel instantly that he is my friend because he has touched upon what I think is the raw of the whole question. What has taken place with reference to the child — and I find it impossible to make my friends who are philanthropic appreciate it, I find it out of question to persuade an academic atmosphere to understand it, and I am glad to find that a man in practical life sees how important it is — what has taken place with reference to the child industrially is that modern society found the child an industrial asset and it has left the child an industrial liability; it found the child an industrial aid to the support of the family at every point, and it has left the child a burden upon the family at every point. We mistake wholly the signs of the future, if we do not understand that it is absolutely necessary

that we should recast with reference to the support of the child our conceptions as to the duty and responsibility of the family when society has stepped in and wholly changed the importance of the child. If you will go in a negro community where I have spent some time and seen a wage earner die and leave five or six children, you will find instantly that you can place every one of those children in a family which desires that child, will take care of it and treating it as one of their own, neither overworking it, our negro friends rarely overwork, [laughter] nor neglecting it. That is because in a primitive condition such as obtains over most of the South today the child is an industrial asset. Let the head of a family die in one of our northern cities, and you instantly have to have an aid society to organize placing those children, and you and I must put our hands in our pockets and support those children until they reach adult life or the years at which they can begin to work.

Now what we see with reference to the child which has lost its wage earner is going on through the entire community, and the result is that with reference to the child, the training, the provision of the child, it is necessary that we should face the fact that by making education compulsory, by advancing the age at which the child may work and by requiring of the family the child clothed and shod and provided for — for there is an unwritten law as strong as that of the statute book that the barefoot child in a modern city cannot go to school — we have turned the child into a liability, and we have got to face the fact by providing for this as it is. Now I desire to draw your attention to the second side which my friend has touched upon as it is. If you divide the community according to incomes so that you put them in four separate piles, the lowest quarter being the quarter by population which have the smallest incomes, you will find that this lowest quarter produces half the children of the community, that the two lower quarters produce from two-thirds to seven-eights of the children in the community and that the directing class is producing a fraction so small that every directing family in New England, with here and there a rare exception, dies out in three or four generations.

Now, I have placed before you the two great problems which relate to the child, which my friend, Mr. DRAPER has touched upon. I simply rose to add to what I have said, — because I was necessiarily restricted for time — that we must understand that if we are going to improve the most important output which a community has, immeasurably more important than the output of any factory, the output of its children, it is indispensibly necessary that we should increase our taxation to the point where it is possible to change our social views, to the point at which it is practicable and deliberately seek to arrange matters so that the child which has become a liability as far as the family is concerned shall be provided for, directly or indirectly, by the state, or what will happen will be that the two middle quarters from which the future life of every community comes, which have not the advantages of the upper, which at least has wealth and brings up its children easily — which has not the lack of prudence of the lower quarter, which is already producing half your future population — those two middle quarters will cease to produce children and your civilization will perish as did that of Rome, not because the barbarian came in, but because the class which could supply the direction of the future ceased to provide the state with children. [Applause.]

The PRESIDENT. I am sure we all feel indebted to Dr. WILLIAMS for his able presentation of the question of child labor. We have gotten something to think about and on behalf of the Association I tender him our thanks for the address which he has given us this evening.

The two remaining papers of the evening are on topics in an entirely different line from that to which we have listened. The first is on Singeing by Mr. EDWIN H. MARBLE, of Worcester.

SINGEING.

EDWIN H. MARBLE, Worcester, Mass.

The process of singeing by means of a gas flame, is of comparatively recent origin, having as yet not reached its century mark. The plate singer is evidently a very little older, the first mention of such a machine known to the writer being in a British patent of 1800. This patent outlines a process in which the fabric is passed over an iron cylinder into which fire has been placed. After giving some details the inventor adds, "The goods will have to be passed several times over this cylinder, to produce the desired effect." Early French and German accounts mention heated metal cylinders or plates as in use about this date. In 1820 we find mention of a flame singeing machine. The character of the flame is not given, but evidently it was obtained from spirits or alcohol, and we notice that the singeing was applicable only to a lacey or netted fabric. The description reads as follows:

"The fabric being passed directly through the centre of the flame, the meshes or netting is singed to present a more thready appearance —to further improve this effect, above the cloth and directly over the flame is placed a tube, extending across the goods from selvedge to selvedge, a longitudinal slot or opening in the tube comes against the fabric; by means of an exhaust pump a partial vacuum is caused in the tube and the inrush of air to fill this vacuum, causes a portion of the flame to be drawn through the openings in the cloth, thus thoroughly clearing the net or lace of any projecting fibres."

Will it be necessary for me to call attention to the fact that in this enlightened age, we are singeing lace goods by a machine identical in principle to that patented in 1820. The

much written up "Bender" system is but a slight modification of this invention. Following along the history of early processes of singeing, we find from 1820 to 1848 several modifications of flame and plate singers and various combinations of the two, with some curious deductions. One party going to the point of distinguishing between the effect upon the cloth, of plates made of different metals, and claims great advantages for a three-plate machine in which the first two plates are of iron and the last or finishing plate is of copper. He gives no reason for this discriminating and leaves the subject as open for discussion as it was before. Prior to 1848 all of the flames were of the open pattern, *i. e.*, without the application of air except to the exterior of the flame—and that these machines were somewhat unsatisfactory one may judge from this abstract from an article by a French textile writer of 1849 or 1850. Of the machines then in use he says:

"The various attempts to remove the fluff or down from fabrics or to render more sightly the nettins and laces by means of hot air or flames, we cannot approve of, they are very expensive, unclean and tedious; until they can find a much greatly improved mechanism, we much prefer the heated plate."

Almost the first application to the mechanical arts of the burner invented by BUNSEN was seen in the singeing machine. A tube with flattened or broadened outlet was used to produce a flat flame, the air admitted at the base, and allowed to thoroughly mix before being ignited at the outlet, gave a clear blue frame, devoid of smoke or unconsumed particles of carbon. This single change, in 1852, increased the capacity of the singeing flame from four to six fold, and was the means of awakening a new interest in gas singeing. Numerous modifications of this principle were made between 1852 and 1862, and of these, the two most important were those of Tulpin in 1862 and Blanche in 1860–1863. In fact, today nearly every singeing machine built has embodied in it for its flame application one of these two designs—differing somewhat in outward

appearances, the principle involved in these two is radically different, yet so closely allied that the Blanche machine can be used as if it were a limited Tulpin, and the Tulpin can be changed in its operation to a Blanche. Briefly outlined, the Tulpin action is as a mowing off of the projecting fibres at their base, and afterwards consuming them, while the Blanche depends on a complete consumption of the fibre as it projects from the fabric. As usually constructed, the Tulpin flame passes between two rolls, the cloth thus being in contact with each flame twice, while the Blanche flame is projected directly upon the roll around which the cloth passes. Each method has its advocates and much discussion might be raised upon the uses to which each principle can be best applied. Connected as I am with the building of singeing machines would prevent a public discussion of the subject at this time.

Until within a few years all of the singeing flames had been made up of a series of flames, projected from tubes with flattened outlets, and each tube required an independent adjustment and regulation. The original Tulpin tube is here shown and it is a fair example of a larger part of those used. This independent construction necessitated a very careful adjustment of each tube, to give an equal area of flame across the fabric, and the lack of perfect adjustment caused many samples to show streaks. Most of these burners were using the air at atmospheric pressure. A few later burners were arranged with air pressure appliances that increased the efficiency but also added to the liability to streak. Who first introduced the continuous slot burner cannot be said, though the earliest application known to the writer was on machines built in Worcester, Mass. Enough to say, that it was an advance equally as imporant to the singeing as was the adoption of the Bunsen principle of burner.

The writer was in hopes of being able to present an account in detail of some experiments with an electric singeing machine, but only the most incomplete data is obtainable. Several foreign announcements of valuable improvements in electric singeing

devices having been noted, a series of careful inquiries were made and only a little can be said on the subject. The Electric singeing machine exhibited by Messrs. MATHER & PLATT in 1887, had for its singeing element a platinum wire embedded in a rod of plater. The current of electricity passing through the wire caused it to become incandescent and theoretically at least, in a condition to singe any cloth brought into contact with it. If a manufacturer had enough electricity and not very much cloth, the machine could be made to singe satisfactorily, but far from economically. A second condition was discovered. On certain kinds of cloth a resultant product of combustion was an almost insoluable film, which adhering to the wire, increased its resistance and in a like proportion decreased its singeing value. This machine was not a practical success and was soon abandoned. About 1893 or 1894, a modification was shown, in which the wire was wound spirally about an earthen core, and thus sustained, was brought into contact with the cloth. If it was difficult to maintain a metallic wire thirty-six inches to forty inches in length, at an incandescent heat, the increasing the length of the wire three and one-half times certainly did not decrease the cost of heating. The contact of the cold cloth upon this heated wire is enough of itself to use up a very large amount of electrical energy and as a commercial singeing experiment it was a decided failure.

The expense of renewing the platinum as well as the expense of heating to incandescense are the great obstacles to this method of singeing. If this could be overcome or a cheaper medium than platinum be used efficiently, the method has many advantages. The advent of cheaper electric power alone seems to be the solution of this problem.

To give a full analysis of the different gases used in singing machines, would take more time than the subject seems to warrant. They may be grouped under five heads : (1) gas from coal or oil, marsh gas, the city gas of our younger days, a slow burning, heavy carbon gas. (2) Water gas, obtained by passing a steam jet across the surface of the incandescent mass

of coke or coal. (3) Producer gas, formerly a by-product of the last, or properly speaking, a low value water gas, now obtained from regularly equipped plants. (4) Gas obtained from gasoline by means of distillation, usually called "retort" gasoline gas. (5) Gas obtained from gasoline by passing a current of air across the exposed surface, an "absorption" or "suction gas." These five, or a combination of two or more of the first three, are practically all of the gases used commercially at this time. Gases obtained from alcohol, wood alcohol, and other spirits; and ascetylene gas as yet have not, to the knowledge of the writer, been brought into anything more than experimental use, as applied to the singeing of cloth.

It is usual to take natural gas as a standard in estimating the caloric value of gases and the heat units in the different gases would be expressed as follows: —

Natural gas	1,000
Coal gas	675
Water gas	350
Water gas enriched by coal gas	620-630
Retort gasoline gas of 20 candle power	690
Suction gasoline gas of same candle power varying greatly under different conditions from	560 to 620
Suction gasoline gas of low illuminating value called "fuel gas" or "naphtha gas"	250, 330
Producer gas	150, 160

While these are the values by calorimeter, the singeing values vary, as what may be a thorough combustion, without illumination, under a furnace or in an enclosed space, may have a very different value when used in an open flame, as the opening of a singing burner.

A few moments spent in explaining this will be of value. What we burn in any flame is carbon-monoxide, hydrogen and hydo-carbons; the singeing value being governed by the proportions in which these elements are united and the circumstances under which the combination is brought to a burning temperature. Water gas contains a mixture of two parts car-

bon monoxide and two of hydrogen, with little or no hydrocarbons. It requires two volumes of this gas to produce complete combustion, coal gas or "marsh gas" high hydrocarbon gas requires four times its volume of oxygen. These two are the elementary gases that enter into every commercial gas and it is a comparatively easy matter to show the amount of oxygen required in any mixture of the two elementaries.

Each unit of air giving us only one-fifth of a unit of oxygen, we express the proportions in air mixtures as follows — four volumes of gas requires forty units of air; half water gas and half marsh gas requires twenty-five units, while the pure water gas requires but ten units of air. It must not be gathered from these figures that heat is developed in a like proportion. Hydrogen with oxygen added forms a chemical mixture of H_2O or water, which as converted in steam a much greater heat value is obtained than when the oxygen unites with a carbon compound to form carbondioxide or CO_2. The hydrogen giving of itself the hottest flame known; in some of its compounds it develops the hottest singeing flame yet discovered.

Another most important point to consider is the time that it takes to form this union of gas and the resultant combustion of the same. You say it is an infinitesimal time when free, yet it is quite a perceptible time when the mixture is confined. It is a fact that the combustion takes place so rapidly in some cases that the gas has very little singeing value. An experiment which our teachers used to try, was to lay two trains of gun powder at right angles one with the other, and touching one end of a train the flash would follow that line so rapidly that the intersecting train would be unconsumed. This is a fair example of some gases. The combustion is so rapid that the fibre which intersects the flame is hardly consumed, while a slower burning gas, in which the fibre remains longer, will do much better singeing.

I have purposely omitted extended notice of gasoline gas in these comparative values, as the value of the gas obtained varies so much, that a fuller account would be necessary.

The different gases obtained from gasoline enter at the present time quite largely into the consideration of singeing. The earlier gasoline gas machine was used solely because no city gas was obtainable. It was at the best a rather poor substitute, being devoid of any method of regulating the quantity or quality of the gas. The sudden change from singeing that called for a capacity of twelve or fifteen cubic feet per minute to a complete shutting off of all demand, was the cause of much trouble. The suction or cold process machines were liable to refuse to work, the excessive evaporation causing refrigeration or complete chilling of the vapor. These machines being improved by means of steam heat, gave much better service, yet still liable to irregular action. As the gas obtained from these machines was from fourteen to twenty candle power and could be used much the same as gas obtained from coal, the machine when well operated gave fair results, subject to the lack of a thoroughly automatic control of quality and quantity of gas. By reducing the quality of the gas to about two to two and one-half candle power and furnishing what is usually called "fuel gas" injecting air into the machine so as to produce a pressure of two and one-half to three inches, it gave a compound of about ninety-four parts air and six parts gas. The flame from this compound was wholly devoid of illumination worth, and of very low caloric value. This compound can be furnished at a very low cost per thousand cubic feet, but its singeing value is about in proportion to its cost.

With gasoline gas, obtained from some of the best "retort," steam or other machines dependent upon a distillate process, very satisfactory results are obtained. A very good gas of about twelve to twelve and one-half candle power can be obtained from four gallons of gasoline of about eighty-five degrees, or from about five and one-half gallons of seventy-six degrees. This gas is of very even quality and from its method of making is not subject to the variations found in the suction machines.

The cost of gasoline will determine in a great measure the

use of one of the machines when brought into competition with city gas.

The writer can recall the time when the Standard Oil Co. or its agents were anxious to have bleacheries put in gas making machines to use up the accumulating stock of gasoline. Eight cents per gallon by the barrel was a high figure, and as an inducement, a liberal price was allowed for the empty barrel, about twice what its market value was. There was no reduction in the price of the gasoline, only they wanted the barrel back again so as to refill it as soon as possible. The steady advance in the price of gasoline, (without any additional cost in the making of the same,) has put the price at about sixteen cents at the present time. While a good singeing gas of seven hundred and twenty caloric value could be formerly made for about forty-eight cents per thousand cubic feet, today it is costing about eighty cents to produce an equal gas. The makers of gas machines have been considering the substitution of wood alcohol or similar spirit for the gasoline, and I trust the experiments will be as satisfactory from the commercial side as they are from the theoretic side. A report recently received by the writer gives promise of the success of the experiment.

It is comparatively easy to obtain the cost of singeing when the gasoline gas machine is used, as the number of yards of cloth can be obtained and the number of gallons of gasoline used to produce the gas, the cost of the attention to the gasoline gas machine and the cost of the attendants who run the singeing machine, suitable provision being made for interest on investment, etc. In each case the cost would be figured a little differently and the writer would simply give surface yards of cloth and amount of gasoline.

In one test, 90,000 yards of fine white muslins and lawns were well singed, both sides, in nine running hours, using fifty gallons of gasoline in a "steam" gasoline gas machine. The cost of the gasoline was twelve and one-half cents per gallon, net, and no labor was required except that directly connected with the handling of the cloth.

From a second establishment the following was given: A week's run of sixty-four hours actual running time gave 504,864 yards of light weight goods, both sides, of an average width of forty-two inches; two hundred and forty-eight gallons of gasoline was used costing $39.68 net; two hours' time was required to fill the gasoline tanks, and the attendant at singer received $9.96 in wages, a total labor expense of $10.36. This gas was also from a "steam" gasoline gas machine.

With suction or absortion gasoline gas the results are not quite as satisfactory, though some figures were very similar to the above. With producer gas, figures still lower were obtained, but a low cost of gas was given as it was using up a by-product of a regular gas plant and figured at a very nominal sum.

A comparison of gasoline gas and city gas has been made in two instances with results very favorable to the former when gasoline could be purchased for sixteen cents or less, and city gas, twenty-five per cent. to thirty per cent. water gas, cost $1.05 net. One establishment figures a saving of fourteen and one-half cents per running hour for gasoline gas under these conditions.

In making any definite statements as to the comparative merits of different singeing appliances, at least three different elements must enter into the deductions. The quality of the singeing; the condition of the fabric before singeing; and the most economical mixture of gas and air to produce the singeing flame. What test have you for comparing the quality of the singeing? The goods are usually wet out at once, they may be hand wrung out and rubbed, but it is simply a matter of the judgment of the tester, his eye being the only means of determining the efficiency or inefficiency of the work; again two similar pieces of cloth may be used for entirely different purposes and what would be satisfactory in one case, be far from close enough in the second. This test must be only a comparative one.

It is sometimes asked how can I determine if my machine is doing all that the builder intended it should? He has adjusted it to suit the particular gas furnished by the "works" connected

with his establishment, while I may be using an entirely different gas, at a different pressure, requiring a different quantity of air at a different pressure. Such questions can only be answered theoretically—a few experiments would probably help to solve problem.

Some of the larger foreign concerns have a regularly appointed experimental engineer, who is endeavoring to increase the output, improve the quality and decrease the expense. These experiments are carried on along general lines and the entire plant is practically put under his control. Careful figures are taken of each step in the process under consideration, and the condition of the cloth noted. These experiments are almost always of great value in determining how far the theoretic formulas may be found to be commercially efficient. Some of the results of singeing experiments are very valuable and as tabulated give us much information that can be used to advantage.

Few of the American concerns employ such a man and are content to take the machine furnished and do the best they can with it. Enough to say that most of the American made machines are built upon lines that best meet the general conditions, and seem to be giving good satisfaction, though no doubt some could be adjusted by an expert of such a character as referred to, to better the quality and quantity of the output.

The changes made by the gas companies in the composition of the city gas, are almost wholly directed toward high illuminating value and the use of that same gas for singeing purposes is only a minor consideration. It is thought that should the amount called for be such as to warrant the building of a gas plant solely for the production of a high value singeing gas, such a plant would show a great economy over any city gas or any combination of gas making appliances now in use.

The lack of complete singeing may be owing not alone to the quality of the flame, but to the improper adjustment of the contact or burner rolls to the flame. The hottest part of the flame should come in contact with the cloth at a point horizontally

opposite the centre of the roll. Now you ask me how to determine the hottest point of the flame. Careful observation would decide if one is familiar with flames, but but this simple device will help determine. Along two feet of stick drive a series of wire nails about three inches apart, remove the burner roll so as to have clear access to the flame, rest the first nail on the burner and raise the last nail about five or six inches above the burner, keeping all the nails in the flame. As the nails are brought to a red heat by the flame it is readily seen the distance above the burner outlet where the flame shows the hottest, and the centre of the burner roll should be set at this level.

A second consideration is the perfectness of the combustion. A plate of copper held against the flame is a good test for the amount of oxygen. If it becomes sooted, not enough oxygen is furnished, if it turns black with the blackened oxide of copper, it is evident that we have an excess of oxygen.

In giving data collected from American establishments, the writer would thank some of the members of this Association who have kindly furnished important information on this subject, and this data as compared with such as is obtainable from foreign sources, shows that we are getting results quite as favorable as are they. In making this statement, do not think that we are perfect in this department, as it is quite evident that a little more attention would improve conditions, and in some instances show a marked decrease in cost. The gas used varied from a high quality hydrocarbon made from coal, of a calorimeter test nearly 700, to a compound of 50 per cent. coal gas and 50 per cent. water gas which has not above 630 units. Tests abroad, place this last as about 18 per cent. less singeing value than the first, — judging from figures obtained from American establishments it is from 10 per cent. to 15 per cent. less value. Though it is difficult to compare values unless conditions are identical.

The usual practice is to take the gas direct from the mains, controlling the irregular pressure by means of a mercury governor, this pressure, as controlled, should not show variation greater than from two and three-fourths inches to three inches

water column. The air is supplied either by direct connected blower or in a few cases one blower supplies several machines. A pressure of about four and one-half inches is sufficient in most cases, though a greater pressure can be cut down by the regulating valves.

The gas costs from 85 cents to $1.05 per thousand feet, and in a few instances the gas companies have realized that the gas used for singeing, as well as other manufacturing purposes, can be furnished during the day time at a less rate per thousand than during the regular illuminating hours, and when an establishment uses from 50,000 to 75,000 feet per week it is quite an item to be considered from the financial side.

In one instance, within a few hours, goods varying from four yards to a pound, to some of which it required thirteen and one-half yards to weigh a pound, were run, the only adjustment being in the flame. The cost of this was a little less than one mill per running yard, the goods averaging 32 inches in width.

With a gas containing about 25 per cent. water gas, costing 90 cents per thousand feet, the average cost per square yard was approximately one mill.

A test made on 30-inch goods weighing 3.9 yards per pound gives a cost of about 17½ cents per thousand yards. This was obtained from gas of the proportions of 60 per cent. water gas, 40 per cent. coal gas, and about 640 heat units. On a fine lawn, sheer-finished, a run of ten hours duration was made under careful supervision with a city gas which contained about 25 per cent. of water gas. The goods were taken from a warm dry room and four burners were used, two for each side of the goods. Everything was favorable to the best results, and a speed of 120 yards per minute maintained. The gas cost per thousand square yards of cloth a little less than 13 cents. The goods were evenly singed and the mesh was cleaned out so as to show a lacey fabric. A heavy threaded open fabric, in fancy design, which called for a very lacey singe, was handled for about 17 cents on the same machine and under similar conditions.

In some of our establishments, the singeing machine is run in

connection with a shearing machine with very satisfactory results. The shear removing the longer threads as well as much of the nap or fluff, and the goods thus prepared are much more cheaply handled on the singer. By an arrangement of connections and drive, the machines are easily operated and the adjustments are such that the strain on the cloth is reduced to a minimum.

While most of the establishments are obliged to handle all weights of fabrics, a few that confine themselves to one particular line of fabrics, are capable of showing very much more satisfactory results. A special outfit for a particular purpose, must show to better advantage than an all round outfit, used as occasion demands.

As already stated the condition of the goods as they come to the singeing machine has much to do with the cost of the work. In the case of sateens, it was found that they contained from 6.5 per cent. to 7.5 per cent. of moisture, and when the goods had laid for sometime open in a damp place, the amount of moisture was increased to ten per cent. This moisture must be removed either by drying the fabric immediately previous to the singeing or in the singeing flame. The cost of each method has been carefully figured out by experts abroad and from a few experiments made in this country. The results while not exactly the same, are very similar.

A French writer has made these deductions. On goods taken directly from stock and depending wholly upon the singeing flame to produce results, it required 5,000 feet of gas. The same goods rough-dried and singed required only 2,550 cubic feet of gas. The loss by moisture was 7.3 per cent. and to dry out this amount nearly 50 per cent. of the gas was used.

An American test showed about 6.8 per cent. of moisture and the same goods were singed at a speed of 115 yards per minute rough-dried, and 85 yards per minute as taken from the stock room. The singeing results were as nearly alike as the eye could determine and a saving of about 33 per cent. was figured in the cost of gas. The question of removing the mois-

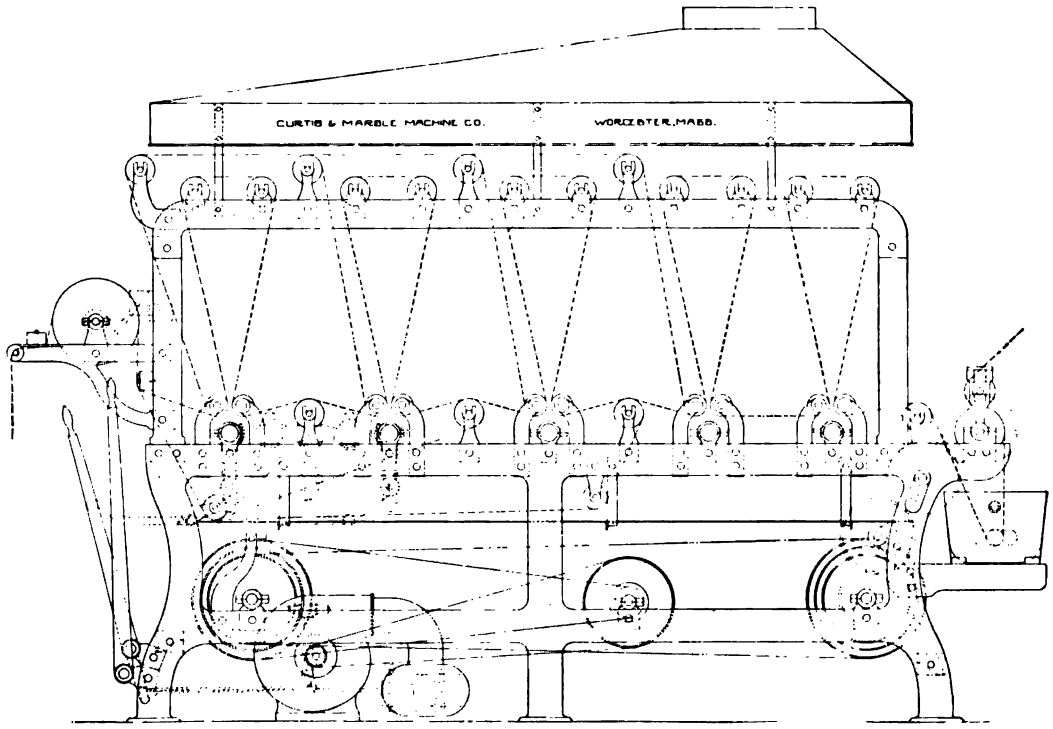
ture by drying cylinders was determined by a comparatively close connection being made from a set of cans to the singeing room, and the cost of running the cans figured. It was found that four cylinders were required to well warm the cloth and eight cylinders rough-dried it. To sum up the conclusion of the experimenter, he expressed himself substantially as follows: "Four gas flames are a great deal more convenient and cost less than two gas flames and the nuisance of a set of drying cans running in connection with them."

Some foreign test results in the following deductions. If gas of 650 heat units is furnished at 85 cents per 1,000 cubic feet, it is cheaper to use the flame than the cans. At 90 cents, the results were about equal on ordinary sateens, and above that figure per 1,000 cubic feet the advantage was in favor of the cans. These figures seem to include only the steam and gas costs, extra attendance not being considered.

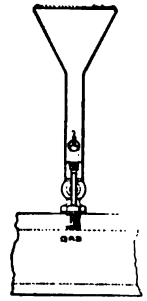
In conversation with a German superintendent, he states that at two establishments tests were made which showed twelve cans twenty-three inches diameter and two flames produced about the same results that four flames did, the speed of cloth being 124 metres per minute.

A few attempts have been made to combine with the singeing machine a drying device. One or two copper cylinders have been attached so as to warm up the goods. It requires something more than warming and these few cylinders did not seem to produce very satisfactory results, though of course, were a little help. A singeing machine arranged to utilize the heat of combustion, somewhat similar to the economizers attached to the steam plants, might show much better results.

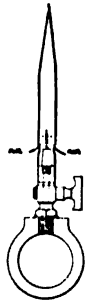
So far as we have studied this subject from the standpoint of a singeing engineer and the results, rather than the machine have been considered. Let me now drop that part and endeavor to occupy the position of mechanical engineer for the remainder of the time. The accompanying sectional illustration of a five burner singeing machine shows quite clearly the arrangement of the different working parts, the bronze burners, each with its

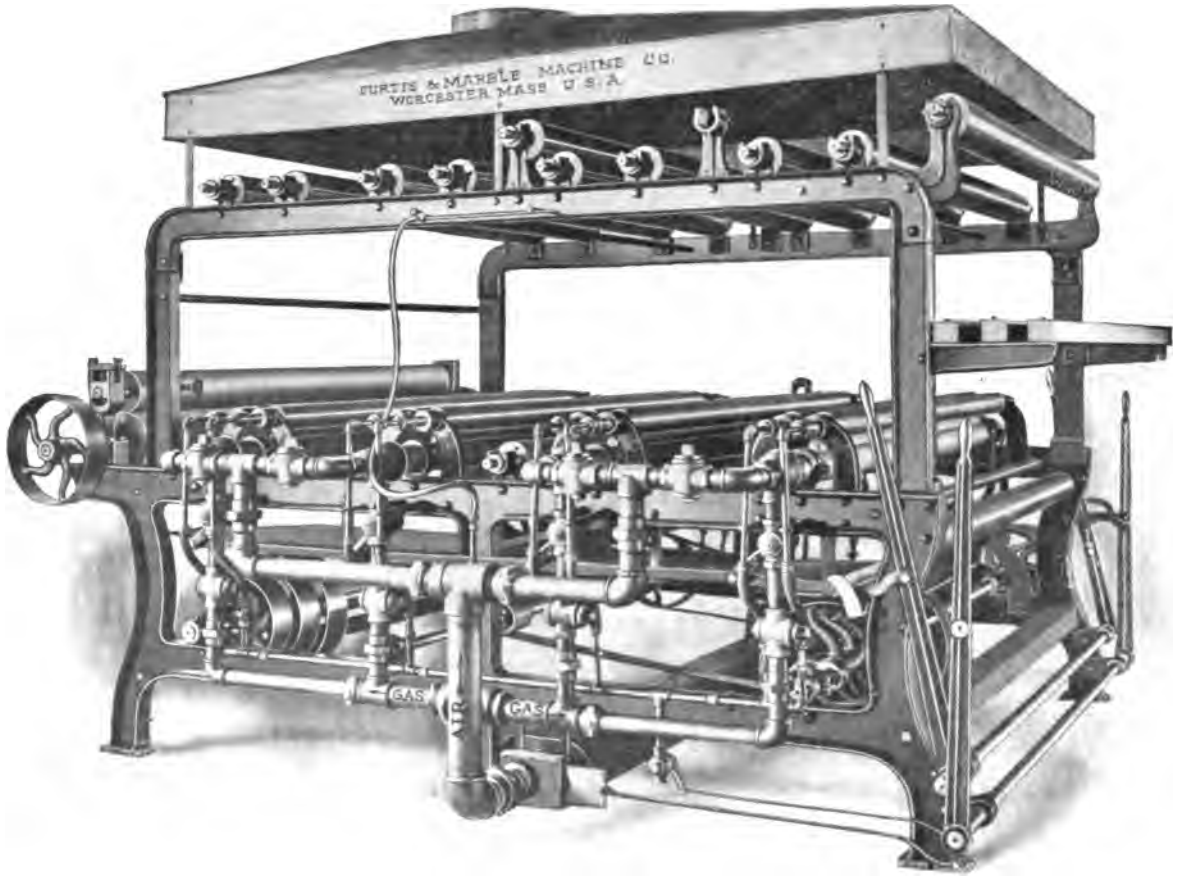


SECTIONAL DRAWING OF FIVE BURNER GAS SINGEING MACHINE.



FRONT AND SIDE VIEW OF "TULPIN" SINGLE TUBE BURNER.





FOUR BURNER GAS SINGEING MACHINE.

pair of bronze burner rolls, the brass carrier rolls, so located that of the five burners, one or two can be used for the first side singed and the remaining burners for the other side or all of the burners can be used on one side of the goods. The high arch gives ample run of cloth between the flame contacts. The gas and air for each burner is controlled by independent cocks while the shut-off cock for the gas is operated by the lever in front. This same lever is connected to the air supply pipe valve, in such a manner that while the gas is let on before the air so as to give easy lighting, it also is cut off before the air so that any unconsumed portion of gas and air in the burner is blown out by the last portion of the air blast. A smoke hood over the entire machine is arranged to catch the larger part of the products of combustion and unconsumed portions, and from this a pipe carries off the same to the chimney. At the front of the machine is attached a measuring drum and recording dial and at the back is placed a water-box through which the goods pass before they are squeezed out by the draft rolls. These draft rolls are metallic and gear-driven, the lower one either felt jacketed or rubber covered and the top of brass. The cloth passes from this machine to either creel or folding-down device or it may be carried through "dead eyes in" rope form to the pit. To allow a change of speed of cloth, a set of cone pulleys is provided, the belts connecting the same being guarded from any droppings from the flames or cloth. The blower is driven through countershaft direct from main shaft and any varying of the speed of cloth does not affect this.

To show the details of construction of this model of a singeing machine, a perspective view of a similar machine having four burners is shown. This gives a somewhat clearer idea of most of the parts referred to. The machine here shown is arranged particularly for heavier fabrics, either cotton or worsted and is the type of machine which has been installed into some of the leading worsted mills in the country. It is not the place to go into data regarding this department of the worsted industry, enough to say that were the advantages of singeing better

understood by the manufacturers, a much larger number of this style of machine would be used.

In this illustration the adjusting cocks and the shut-off cocks show very clearly, as does the wind-valve. A particular part of the machine not shown in the section should be referred to. The rolls, above the burners are called burner-rolls, to distingush them from the carrier-rolls on the arches. These burner-rolls are usually provided with water connections and from the inlet pipe a small stream of water is allowed to circulate through the rolls, keeping them cool and avoiding any tendency to impoverish the goods, as the goods are usually run. The outlet pipe for these rolls is arranged so as to prevent any siphoning of the rolls, though they can be emptied to the centre if desired. Should one require a singeing between the meshes or openwork of the fabric it is very easy to run the goods from burner-roll to burner-roll through the flame, or by raising the centre of the second of each pair of burner-rolls above the level of the first, so that the flame strikes against the first roll more direct and thence deflects itself to the second roll, by this means some goods are singed much more advantageously. Again it is possible to use but one of the two carrier rolls on the arch, around which the cloth passes from its first to its second contact with the flame, the cloth being thus brought closer together. The flame is much more confined and on heavy weight goods a greater amount of singeing can be done. This should not be practiced with light weight fabrics as the flame has a tendency to burst through the goods and impoverish them.

It should be understood that these illustrations show only two arrangements of singeing machines built, and variations in the number of burners are possible, different tension devices can be applied in front and rolling-up brackets of several designs may be attached at the back. It is often found quite desirable to adapt the singeing machine to the kind of goods that are handled in the largest quantity and modify its handling to suit those singed in smaller quantity.

While this paper has covered a little of the subject, it is hoped

that it will awaken an interest in this department of the establishment so that some of the members will carry out a series of experiments that will determine the conditions best adapted to obtain the largest returns and if at any time the writer can be of any assistance, his services are at the disposal of the members.

Mr. EDWIN H. MARBLE. A gentleman informed me today of results obtained in Kansas in obtaining gas from wood alcohol or ligneous acid which seemed to show some advantageous points and which I trust eventually will have some influence toward regulating the price of gasoline and the use of gasoline for singeing purposes. There are one or two mechanical processes which must be made to complete the experiments.

The PRESIDENT. Our business is a many-sided one and I have no doubt this paper on Singeing will be of value to many of our members who are not here but will be able to read it in the Transactions.

The last paper on the program is on Steam Boiler Insurance; a Conservor of Credit, by Mr. HUGH NELSON of New York City.

Mr. HUGH NELSON. Mr. Chairman, ladies and gentlemen. I must confess a little embarassment when I feel that I am to close a program which has been so replete with the most interesting papers so ably presented. My only comfort is in the words of the Good Book, "The last shall be first."

STEAM BOILER INSURANCE; A CONSERVER OF CREDIT.

HUGH NELSON, 52 William Street, New York City.

At a gathering of this character where questions of raw material, manufacture and marketing of goods, mill equipment and machinery and other kindred subjects, directly affecting the textile manufacturer and mill owner, are the ordinary topics of discussion, a paper dealing with a matter of insurance may at first blush seem ill-timed and out of place. However, at previous meetings of this Association, papers treating on some particular class or form of insurance have been presented and made subjects of discussion, and remembering that the current year has been a most eventful one in the history of insurance, and one fraught with problems of great moment to underwriters generally as well as to the insuring public, I feel that I may be able to present for your consideration, a subject not entirely devoid of interest. In the field of life insurance, the public demand for reform, both at home and abroad, has invaded legislative halls, and as a result laws have been passed which should cause a peaceable solution of the difficulties between insurer and insured. The recent appalling catastrophe on our western coast with its far reaching results in the way of monetary loss and financial disaster, at which the whole civilized world stood aghast, illustrates most strikingly the great value of insurance corporations to a community in emergencies of this character, bringing about the prompt restoration of credit and the starting of the wheels of industry anew. Such results, however, must of necessity cause a heavy drain upon the surplus of the companies, thus entailing increased responsibilities and problems in which both insurer and insured must for mutual protection

take a deep interest. The casualty underwriter is also going through a period of doubt and anxiety, when he scans the records of increased losses, and realizes that the statutes of many states are placing upon the employer of labor additional burdens and responsibilities, while granting to the employee added protection and enlarged privileges in case of accident. In the light of these facts is it not fair to presume that the manufacturer and mill owner, who is as well a steam user, is interested in the discussion of a question having a direct bearing not only upon the efficiency of his motive power, but also upon the still broader question of placing the financial responsibility in case of disaster?

The boiler and engine room in the modern up-to-date mill present most interesting problems. The energies of the mechanical engineer have been taxed to bring about the greatest possible efficiency in motive power with a due regard to economy in fuel. The old locomotive boiler of forty years ago has been generally discarded for the latest and most approved type embracing in its composition the combined result of mechanical invention and scientific thought. A visit to the boiler room of the modern mill will give one an idea of the large outlay necessary for the equipment of a steam plant that will meet the requirements and conditions of today. Having expended much time and money in perfecting his plant, the prudent manufacturer will take every precaution to maintain the same in the best possible condition. The most important step in that direction lies in securing the services of an expert inspector whose practised eye and trusty hammer should discover any defect or imperfection, and whose experience and skill should enable him to apply or suggest a prompt remedy for the trouble. The lot of the boiler inspector of today is not an enviable one; criticized by superintendent or engineer because he embodies in his report a statement of the true condition of a badly managed steam plant, or calls attention to defects that require the expenditure of money; pronounced incompetent by the boiler manufacturer because he discovers that a failure to observe

closely the specifications and plans has resulted in a badly constructed boiler, he is finally compelled to shoulder the responsibility and frequently the blame in case of explosion and consequent loss. While few will speak of the valuable services rendered by a conscientious expert of this character, it is a well known fact that to his watchful care is frequently due the preservation of property and life. It is a matter of absolute proof from the statistics of nearly half a century, that not only the efficiency, but the life of the boiler, if we may use such a term as applied to an inanimate object, is greatly enhanced by a periodical inspection under the trained hand and eye of the expert. It is frequently said that the engineer is an expert and a most capable man, and that no other inspector is needed.

The most unsatisfactory inspector from a practical standpoint is the man who, day after day, stands by the side of a boiler to which he gives his undivided attention. Wedded to this special type and from constant association thoroughly familiar with its workings, he fails, like the mother whose one child is the darling of her heart, to see its faults or possible defects. Why, may I ask, should the owner of the modern sprinklered cotton mill with all its appliances for the diminution and prevention of loss in case of fire, and subject to the inspection of the expert, fail to safeguard his property and the lives committed to his charge by obtaining the same expert inspection of his boilers and proper protection in case of loss? If the auditor or bank examiner is at times a neccessary visitor to the counting rooms, why should not the outside expert in engineering be equally as important, as an overseer of the steam plant, to discover and correct faults of construction or mismanagement? The textile manufacturer must realize that he has within the four walls of his boiler room a subtle power which, when harnessed and properly controlled, is a harmless and most effective medium for the propulsion of engine and machinery, but when, through lack of vigilance or as the result of some latent defect, it bursts its bonds, no more fearful engine of destruction can be imagined.

Some six months ago in the City of Brockton, Massachusetts, an impressive memorial service was held for the fifty-six victims of the most disastrous boiler explosion ever known in the history of New England. In addition to the fearful sacrifice of human life, a once prosperous mill was in a moment reduced to ashes, and its owners, but yesterday factors in the world of trade, compelled to face financial ruin. No sadder or more pointed illustration can be given of the dread power of confined steam, and no prudent man can fail to profit by the lesson contained therein.

Having considered the question of the value of expert inspection from the standpoint of efficiency of motive power and preservation of property, we pass to the main subject of this treatise, viz: the necessity of protection in case of loss as the result of a steam boiler explosion for the better preservation of the credit of the assured. There are several classes of individuals and corporations whose interests would be vitally affected by any diminution of the producing power of the modern textile mill, as the result of such disaster as referred to above. In the first place the manufacturer must, in addition to the burden of legal responsibility, face the prospect of certain diminution and possible loss of income from a business to which he has devoted the best years of his life. If he is a mill owner as well, in addition to the loss of stock and machinery, there is a still further loss on buildings with the value thereof either impaired or entirely destroyed. Another class of individuals who would be decided sufferers in case of a loss of this character is the commission man or mill agent, who stands between the manufacturer and the distributor. To such a man, whose income is dependent upon the sale of the output of the mill, the loss of the mill's producing power means loss of the season's business and in consequence total loss of income from that particular mill. When we go further and enter the money markets of the world, where the bank, the trust company or the capitalist furnish the manufacturer with the ready money on which he must depend for the purchase of large quantities of raw material, the equipment

of his mills and the prosecution of his business, we at once see the value of the practical safeguards of thorough inspection and the indemnifying contract of an insurance company in case of the destruction of mill and contents by unforseen disaster. The prudent man, whether agent or capitalist usually safeguards his interests by seeking the protection that the fire underwriter grants, and grows fearfully nervous if his policy should lapse for a day or even an hour, and yet such a man will without apparent concern take his own risk in the case of a loss which may result in a greater destruction of property and sacrifice of life. It must be remembered that the standard form of fire's policy expressly exempts from its provisions loss from an explosion of any kind "except when fire ensues and then for the damage by fire only," so that protection cannot be expected from that source.

In that connection I would like to say that it may not be known to all present, but from statistics it has been proven that in the state of Massachusetts one-fourth of all the boilers are uninsured today and are inspected by no one except the state inspector; and so far as the inspection of the state is concerned, as we all know, it is often entirely superficial.

The day is not far distant when the credit rating companies in order to protect the interests of their customers, will refuse the coveted "A a A I" to any manufacturer who fails to show, as his credentials of ability to meet all obligations, the necessary indemnifying contracts of boiler insurance and protection of profits and income.

In view of these facts shall I be considered a chimerical enthusiast, if I predict for the modern steam boiler contract covering as it does the entire main steam system, as well as indemnifying for loss of property, of life, and profits and income, its classification as an asset in the financial column of the manufacturers' ledger? In this day of broad ideas the manufacturer, mill owner or commission man must in order to keep abreast of the times and safeguard his credit, protect his own financial interests and those committed to his charge by warding off as

long as possible the evil day of disaster, but he should as well be prepared when that day comes, if come it must, to transfer to other shoulders, the heavy burden of financial responsibility, that follows in the train of every such disaster.

Mr. WILLIAM D. HARTSHORNE. Mr. President I will just ask for information in regard to the 25 per cent. of the boilers in Massachusetts not being insured, what class of boilers are they?

Mr. HUGH NELSON. That covers all classes, Mr. HARTSHORNE; heating boilers as well as power boilers. When I speak of heating boilers, I mean heating boilers of a certain pressure. I do not mean plain water heaters, but I mean boilers in apartments and hotels and stores. I do not think there has ever been a classification exclusively of manufacturing plants; at least I cannot get that classification myself. In the state of Vermont, however, I do know that not more than one half of the manufacturing boilers are insured. That I determined from statistics compiled by myself when I was general agent in that state.

The President called for the report of the Committee on Resolutions.

Mr. WILLIAM D. HARTSHORNE. Your committee have received two resolutions and have prepared a few others, which I beg to submit on their behalf:

REPORT OF COMMITTEE ON RESOLUTIONS.

I. *Resolved:* That this Association views with satisfaction the closer relations that are being established between growers and manufacturers, and the efforts being made in the South to improve the ginning and baling of cotton, and expresses the opinion that well handled cotton will command a price that will more than compensate for the extra expense incurred.

II. *Resolved:* That the Secretary of Agriculture respectfully be requested to issue the annual government crop estimate on the same day as the first December ginners' report, which action will, in the opinion of this Association, tend to reduce disturbance to the market.

III. *Resolved:* That the thanks of the National Association of Cotton Manufacturers be and are hereby, tendered to the Honorable JULIUS M. MAYER, Attorney-General of New York, for his very able address of welcome to this Association.

IV. *Resolved:* That the thanks of this Association be and are hereby, tendered to Honorable HARVIE JORDAN, President of the Southern Cotton Association, for his excellent paper upon the relations between the cotton producer and manufacturer, and also to Mr. JOHN MARTIN of Paris, Texas, for his interesting paper upon the relations between the cotton producer and manufacturer and also to TALCOTT WILLIAMS, LL. D., for his able address on Child Labor, and also to Mr. E. L. BROWN, Manager of Hotel Champlain, for the excellent manner in which he has provided for the entertainment of our members and guests.

V. *Resolved:* That this Association learns with regret of the sudden death of HENRY N. NEILL, the eminent cotton statistician of New Orleans.

Respectfully submitted,

WILLIAM D. HARTSHORNE,
J. D. MONTGOMERY.
R. M. MILLER, JR.,
H. F. MANSFIELD,
ROBERT BEATTY.

Committee on Resolutions.

On motion of Mr. WILLIAM D. HARTSHORNE, duly seconded, the foregoing resolutions were unanimously adopted.

The PRESIDENT. I think before we adjourn some reference ought to be made to the good work done by the Committee on Meeting. The Committee has attended diligently and intelligently to the work that was deputed to it and everything has gone smoothly, for which we are indebted to all the members of the committee. We are also much indebted to our Secretary for his usual painstaking work in arranging for this convention and carrying out the details so successfully.

Mr. WILLIAM D. HARTSHORNE. Mr. President, I think it would be well to place upon our records a vote of thanks to the gentlemen to whom you have referred. I therefore move that such a vote be tendered them.

The motion was seconded and unanimously adopted.

On motion of Mr. STEPHEN A. KNIGHT the meeting at ten o'clock P. M., adjourned *sine die*.

Attest:

C. J. H. WOODBURY,
Secretary.

GOLF TOURNAMENT.

The second annual golf tournament to compete for the two cups presented by President MACCOLL in 1905, for players making the best gross and net scores, and won the first year by Messrs. GEORGE A. AYER of Easthampton, Mass., and WILLIAM L. LYALL of Passaic, N. J., was held during the afternoons of Wednesday and Thursday under the auspices of the Committee on Golf, Messrs. ROBERT BURGESS and WILLIAM L. LYALL, who report as follows:

The Golf Committee appointed by the President to direct the Annual Tournament for the MacColl Cups, beg to report a gratifying increase in interest in the Tournament held at the Hotel Champlain meeting, over twenty members taking part in the Tournament this year, while only six participated last fall at Atlantic City.

Much more general interest was also shown by other members, not players, and it is earnestly hoped and expected, that, as was the intent of the donor of the Cups, the annual contest will aid materially in increasing the "get together" spirit so desirable in an organization of this character.

The successful contestants for the Cups this year were Mr. ROBERT BURGESS, winner of the Gross Score Cup, with a gross score of 86 and Mr. WILLIAM L. LYALL, winner of the Handicap Cup, with a net score of 62.

The Committee have determined that it will be best in future to determine the handicap of each player by his score at the Tournament of the previous year. The handicaps of members who have not previously contested will be determined from their club handicaps.

THE GOLF COMMITTEE.

ROBERT BURGESS, *Chairman.*

By the conditions of the gift the names of the winners each year are to be inscribed on the cups, a cup to become the property of any player winning it three successive years.

INDEX.

A

Active Members 19
Aeolipile, Description of . . . 165
Air-Gap in Motors 256
Alphabetical List of Members . 18
Amendments to Charter . . . 4
Associate Members 40
Attendance at Champlain Meeting 73
Ayer, George A., Inquiry on Trouble in Electric Driving . 269
Ayer, George A., On Correspondence Methods of Instruction 119
Ayer, George A., Steam Turbines 240

B

Beatty, Robert, Member Committee on Resolutions . . . 125
Beatty, Robert, Member Committee on Resolutions . . . 343
Belt Diagram 265
Bennett, Orin F., Elected Active Member, Sept. 13, 1906 . . . 298
Board of Government 14
Boiler Insurance, a Conserver of Credit, Hugh Nelson 337
Borden, Richard B., Memorial Sketch of 69
Bowen, Charles A., Member Champlain Meeting Committee 84
Branca Type of Steam Turbine 168
Brand, Jr., James H., Elected Associate Member, Sept. 13, 1906 299
Brooks, Christopher P., Recent Progress in Textile Education 105
Brown, E. L., Resolution of Thanks to 343
Burgess, Robert, Chairman Golf Committee 345
Buckets of Steam Turbines . . 181
Burleigh, Charles B., Curtis Vertical Steam Turbine 164
Burpee, Hermon N., Elected Associate Member, Sept. 13, 1906 299
Butler, Obadiah, Elected Active Member, Sept. 13, 1906 . . . 298

C

Call to Champlain Meeting . . 73
Champlain Meeting, Attendance 73
Champlain Mentioned Cotton in 1609 297
Charter of Association 3
Child Labor in Textile Factory, Talcott Williams 307
Cleaning Motors 257
Clexton, Thomas J., Elected Associate Member, Sept. 13, 1906 299
Colman, Howard D., Automatic Warp Separators, ... 294
Colman, Howard D., Steam Turbines 236
Committee on Champlain Meeting 84
Condensers on Steam Turbines 238

Conference of Cotton Growers and Manufacturers, Resolution of 93
Constitution and By-Laws . . . 8
Cooke, Reuben A., Elected Active Member, Sept. 13, 1906 298
Cooper, James A., Elected Associate Member, Sept. 13, 1906 300
Correspondence Instruction in Textiles 107
Cotton, First Mentioned by Champlain, 1609 297
Cotton, Handling and Marketing of, by Growers, Harvie Jordan, 126
Cotton, Improvement in, Resolution on 343
Curtis Vertical Steam Turbine, Charles B. Burleigh 164

D

Dillon, Frederick N., Member Champlain Meeting Committee 84
Draper, George Otis, Automatic Separators 292
Draper, George Otis, Half Time Schools 314
Draper, George Otis, On Correspondence Method of Instruction 117
Drawing-In of Warps by Machinery, Edgar F. Hathaway . . 285
Driving, Electrical, Practical Experiences in, John A. Fernley 252
Dust in Motors 257

E

Eddy, Jr., Jesse P., Member Committee on Meeting . . . 84
Egyptian Cotton, Arthur A. Haserick 147
Electric Singeing 321
Electric Transmission of Power, John A. Fernley 252
Electrical Driving, Practical Experiences in, John A. Fernley 252
Elsberry, William E., Elected Active Member, Sept. 13, 1906 298
Employment Bureaus, Louis Simpson 120
Experiences in Electrical Driving, John A. Fernley 252

F

Farmer's Union 142
Fernley, John A., Employment Bureaus 123
Fernley, John A. Steam Turbines 236
Firth, William, Scholarship . . 107
Former Officers of the Association 15
Functions of Association . . . 5

G

Geographical Distribution of Members 71
Geographical List of Members . 48
Gerry, Roland, Elected Associate Member, Sept. 13, 1906 300
Golf Prizes 81
Golf Tournament 345
Gordon, C. B., Elected Active Member, Sept. 13, 1906 . . . 298
Government Crop Estimate, Resolution on 343
Grant, Jr., George P., Chairman Committee on Meeting at Lake Champlain 84
Gray, D. W., Maintenance of Electric Driving 269
Grower of Cotton, Outlook for, John Martin 138

H

Handling and Marketing Cotton by Growers, Harvie Jordan . . 126
Hartshorne, William D., Chairman Committee on Resolutions 343

Hartshorne, William D. Chairman Committee on Resolutions 125
Hartshorne, William D., Egyptian Cotton 161
Hartshorne, William D., On Correspondence Methods of Instruction 118
Hartshorne, William D.. Repairs to Motors 266
Hartshorne, William D., Steam Turbines 235
Haserick, Arthur A., Elected Associate Member, Sept 13, 1906 300
Haserick, Arthur A., Egyptian Cotton, ... 147
Hathaway, Edgar F., Drawing of Warps by Machinery . . . 285
Hawes, William C., Elected Associate Member, Sept. 13, 1906 300
Heat Units in Gases 322
Hero's Description of Steam Engines, C. B. Burleigh 165
Hobbs, Charles H., Memorial Sketch of 69
Honorary Members 18
Hotel Champlain, Description of 78
Hotel Champlain, Reception at 162
Howe, Frederic W., Division of Motor Loads 268
Hubbard, Samuel T., Elected Associate Member, Sept. 13, 1906 300

I

Insurance of Steam Boilers, a Conserver of Credit, Hugh Nelson 337
International Federation of Cotton Spinners and Manufacturers at Bremen 95

J

Johnston, David S., Member Champlain Meeting Committee 84
Jordan, Harvie, Handling and Marketing of Cotton by Growers 126
Jordan, Harvie, Resolution of Thanks to 343

K

Kenney, Frank B., Member Champlain Meeting Committee 84
Knight, Stephen A., Direct Selling of Cotton 143
Knowles, John W., Elected Active Member, Sept. 13, 1906 298

L

Labor, Child, Talcott Williams 307
Life Members 18
Long, Oliver N., Elected Active Member, Sept. 13, 1906 . . . 298
Lowe, Arthur H., Repairs of Motors 276
Lowe, Arthur H., Response to Address of Welcome at Champlain Meeting 89
Lowe, Arthur H., Steam Turbines 235
Lubrication of Steam Turbines . 190
Lyall, William L., Member Golf Committee 345
Lyall, William L., Steam Turbines 239

M

MacColl, James R., Address of Welcome at Champlain Meeting 92
MacColl, James R., Child Labor 301
Mansfield, Henry F., Member Champlain Meeting Committee 84
Mansfield, Henry F., Member Committee on Resolutions . . 125

Mansfield, Henry F., Member Committee on Resolutions . . 343
Marble, Edwin H., Elected Associate Member, Sept. 13, 1906 300
Marble, Edwin T., Elected Associate Member. Sept. 13, 1906 300
Marble, Edwin H., On Correspondence Methods of Instruction 117
Marble, Edwin H., Singeing . . 318
Marble, Edwin H., Steam Turbines 242
Marston, John P., Member Champlain Meeting Committee 84
Martin, John, Outlook for Cotton Growers 138
Martin, John, Resolution of Thanks to 343
Mathematics of Steam Turbine 178
Mayer, Hon. Julius M., Address of Welcome at Champlain Meeting 85
Mayer, Julius M., Resolution of Thanks to 342
McFadden, J. Franklin, Elected Associate Member Sept. 13, 1906 300
McLaughlin, R. P., Elected Active Member Sept. 13, 1906 . 298
Members of the Association . . 18
Memorial Sketches 73
Merrill, Meldon H., Electric Driving 281
Miller, Jr., R. M., Member Committee on Resolutions . . . 125
Miller, Jr., R. M., Member Committee on Resolutions . . . 343
Montgomery, J. R., Direct Purchase of Cotton 144
Montgomery, J. R., Member Committee on Resolutions . 125
Montgomery, J. R., Member Committee on Resolutions . 343
Motors, Automatic Switch to . 277
Motors, Delay in Repairing . . 258

N

Nelson, Hugh, Steam Boiler Insurance a Conserver of Credit 337
Nozzles of Steam Turbines . . 180
Number of Members 47

O

Officers of the Association . . 14
Outlook for Cotton Growers, John Martin 138

P

Paine. Sidney B., Automatic Switch to Motors 277
Paine, Sidney B., Loss of Power in Electric Transmission . . 272
Parker, Winthrop, Elected Active Member, Sept. 13, 1906 . 298
Poem on Steam Turbines . . . 234
Power Chart 264
Power, Electric Transmission of, John A. Fernley 252
Practical Experiences in Electrical Driving, John A. Fernley 252
President's Address, Champlain Meeting, James R. MacColl . 92
Program of Champlain Meeting 83

R

Ray, Joseph G., Elected Active Member Sept. 13, 1906 . . . 299
Recent Progress in Textile Education, Christopher P. Brooks 105
Reception at Hotel Champlain . 161
Reciprocatin' Mon 234
Resolutions, Committee on . . 125
Resolutions, Committee on . . 343
Review of Recent Progress in Textile Education in the United States, Christopher P. Brooks 105

Rice, Richard H., Member Champlain Committe on Meeting 84
Rice, Richard H., On Vacuum 241
Rice, Richard H., Steam Turbines 238
Rotary Engine, First Form of 165

S

Sanford, Pardon B., Member Champlain Committee on Meeting 84
Schools, Half-time, George Otis Draper 315
Sheep Stealing, Louis Simpson 121
Sheldon, Arthur N., Elected Associate Member Sept. 13, 1906 300
Simpson, Louis, Employment Bureaus 120
Simpson, Louis, On Lancashire Private Cotton Investigation Commission 102
Singeing, Edwin H. Marble . . 318
Smith, Abbott P., Elected Associate Member Sept. 13, 1906 . 300
Smith, Abbott P., Protection with Electric Driving 271
Starting of Steam Turbines . . 203
Steam Boiler Insurance, a Conserver of Credit, Hugh Nelson 337
Steam Consumption of Turbines 210
Steam Engine, First Form Rotary 165
Steam Engines, History of, C. B. Burleigh 164
Steam Exciter 261
Steam Turbine, Mathematics of 178
Steam Turbines, Poem on . . 234
Steam Velocity, or Efflux . . . 170
Stearns, Willard W., Elected Active Member Sept. 13, 1906 299
Sutro, Paul E., Elected Active Member Sept. 13, 1906 . . . 299
Sweet, James O., Automatic Warp Drawing Machines . . 295
Sweet, James O., Loss of Power in Electric Transmission . . 272
Sweet, James O., On Child Labor 315

T

Tests of Steam Turbines . . . 211
Textile Education Established by Massachusetts 115
Textile Education, Recent Progress in, Christopher P. Brooks 105
Textile Schools, List of 105
Thackeray, Richard, Memorial Sketch of 70
Thompson, David M., Memorial Sketch of 71
Traber, George M., Elected Active Member Sept. 13, 1906 . 299
Transportation to Champlain Meeting 79
Turbine, Steam, Charles B. Burleigh 164

U

Upham, Frederick A., Elected Active Member Sept. 13, 1906 299

W

Warps, Drawing-In by Machinery, Edgar F. Hathaway . . 285
Welcome to Association, Champlain Meeting, Hon. Julius M. Mayer 85
Wheels of Steam Turbines . . 187

Whipple, Walter, Elected Active Member Sept. 13, 1906 . 299
Wilkinson, Jr., E., Elected Active Member Sept. 13, 1906 . 299
Willey, Eugene F., Elected Active Member Sept. 13, 1906 . 299
Williams, Talcott, Child Labor in the Textile Factory . . . 307
Williams, Talcott, Resolution of Thanks to 343
Wood, Kenneth F., Elected Active Member Sept. 13, 1906 . 299
Woodbury, C. J. H., Steam Turbines 236
Woodbury, C. J. H., Textile History of Massachusetts . . 114

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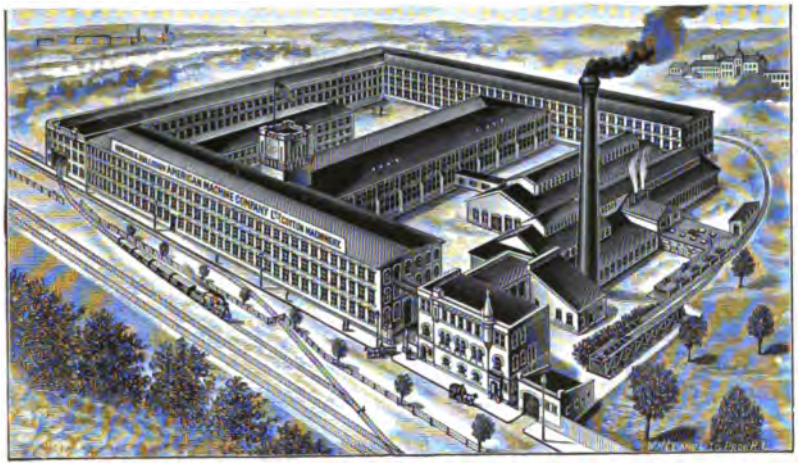

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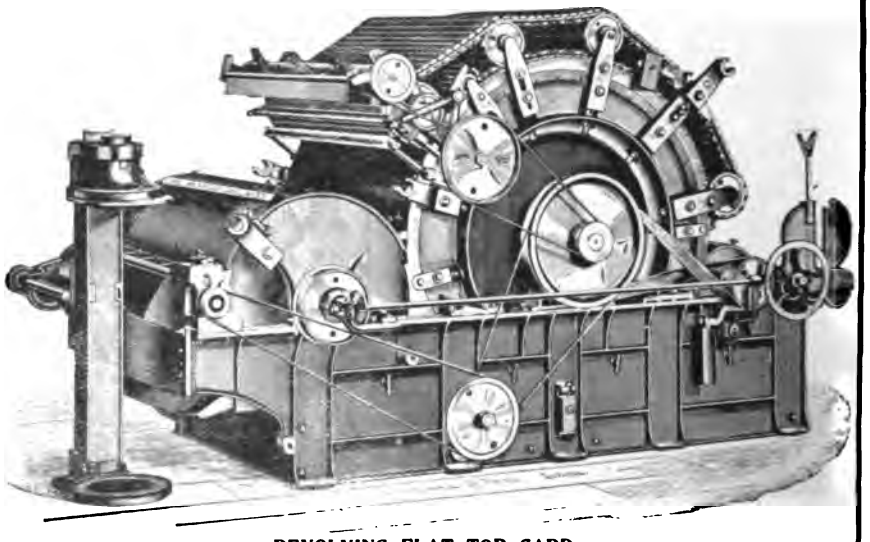

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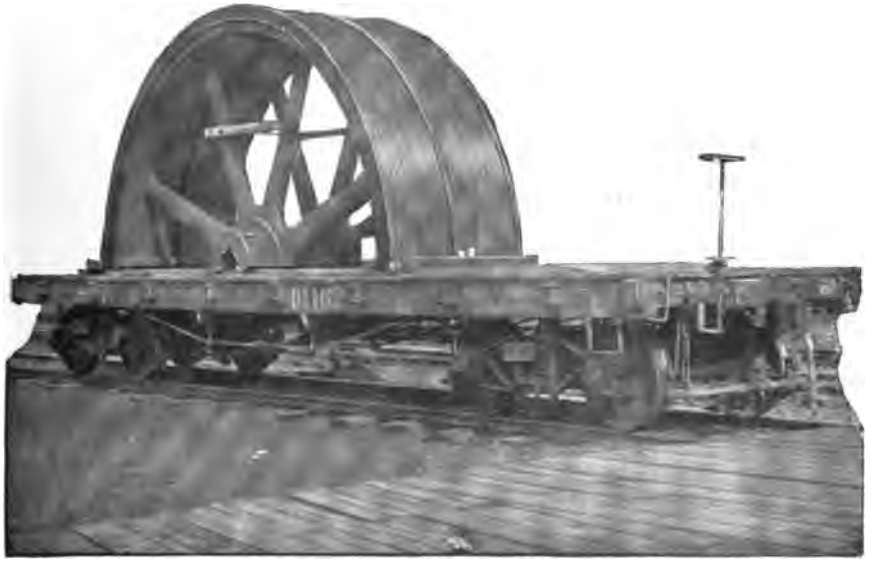

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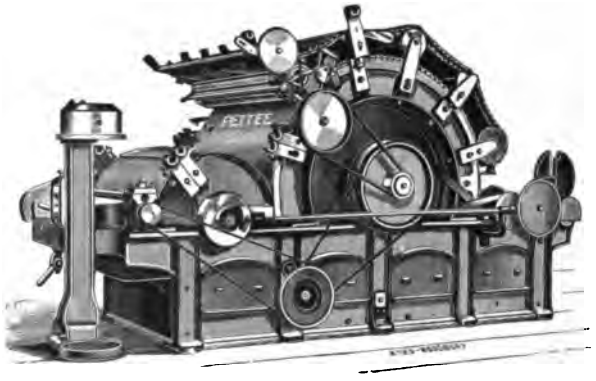

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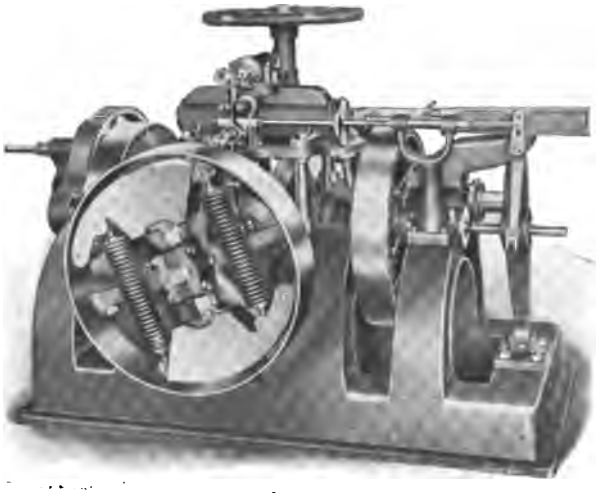

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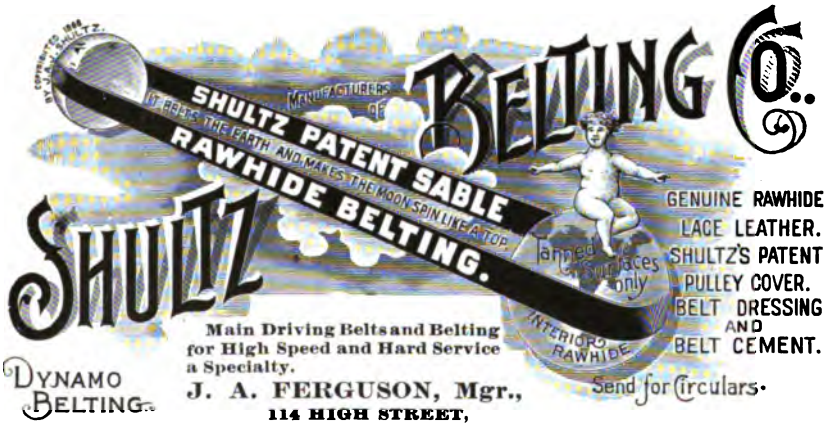

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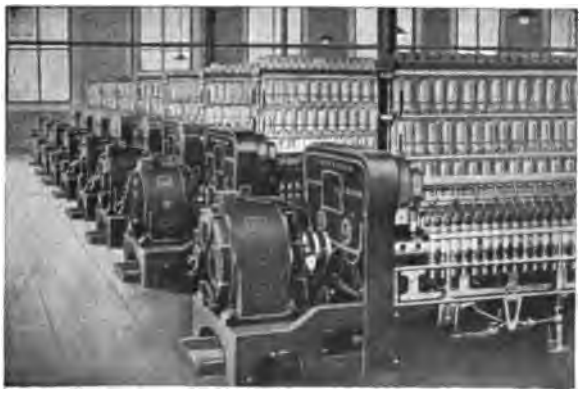

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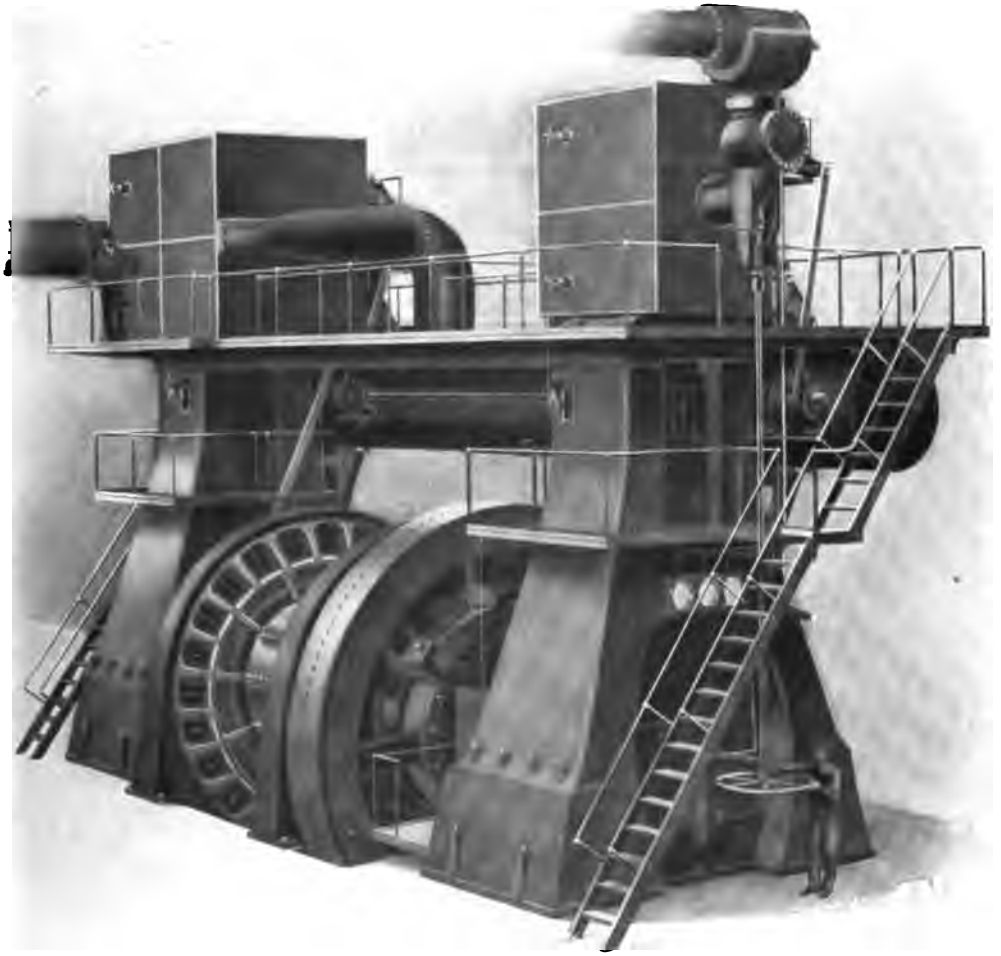

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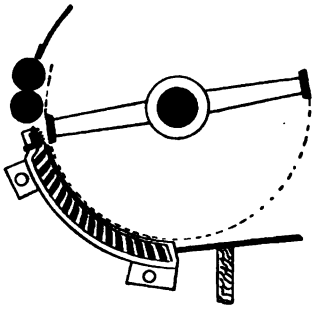

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